

Noise Monitoring Assessment Report

771 Cudgen Road, Cudgen NSW

Prepared for: Lendlease Building Pty Ltd

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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 the Lendlease Group (Lendlease) to assess the levels of construction related noise during the construction of the Tweed Valley Hospital Development Project and associated road upgrades, 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 February 2023.

The road improvement and widening works on Cudgen Road are currently being undertaken and are in close proximity to the SVANTEK Noise and Vibration loggers located at each of the monitoring locations. The roadworks program during the February survey period included activities such as compacting works, asphalt works, trenching activities and services installations.

Noise impacts have been correlated with vibration levels at each of locations; measurable due to the close proximity of works to the sensors and microphones of the data loggers positioned near or on residential properties.

This report finds the following:

- At Location L.005 and L.006, low to no impact of concern has been established
- At Location L.007:
 - Six (6) days of noise levels exceeding the Highly Noise Affected Criteria
 - Four (4) days of high noise levels during works
 - Two of these days were affected by adverse weather conditions.

ADE prepared a Construction Noise and Vibration Impact Statement (CNVIS) for CD Civil which presents mitigation measures for impacted receivers (where feasible and reasonable). These management practices are to be adhered to at all times, together with the noise management practices outlined and approved in the Noise and Vibration Management Sub-Plan (CNVMP), prepared by Lendlease.

The following recommendations and requirements where noted are formulated:

- Letterbox drops to all surrounding sensitive land uses (including the TAFE) and
- Operator Attended Noise Monitoring is required prior to additional trenching at the boundary of the most impacted residential receiver.

Contents

1	Introduction	1
1.1	Introduction	1
1.2	Project background	1
1.2.1	Development consent SSD-10353	2
1.2.2	Monitoring Locations	3
2	Noise criteria	4
2.1	NSW Interim Construction Noise Guideline	4
2.2	Other sensitive land uses and commercial receivers	5
2.3	Residential noise criteria summary	6
3	Results overview	7
3.1	Survey instrumentation and methodology	7
3.1.1	Analysis methodology	7
3.2	Results	8
3.3	Discussion	11
3.3.1	NML exceedances	11
3.3.2	Recommendations	12
4	Conclusion	13
	Appendix I – Glossary	i
	Appendix II – Aerial Imaging	iii
	Appendix III – References	v
	Appendix IV – Site Photographs	vi
	Appendix V – Noise Graphs	x

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 Development Project and associated road upgrades, located at 771 Cudgen Road, Cudgen in New South Wales (hereinafter referred to as 'the Site').

No one section or part of a section of this report should be taken as giving an overall idea of this report. Each section must be read in conjunction with the entire report, including its appendices and attachments.

At the time of noise monitoring, Lendlease superstructure works were continuing on the Site which includes the construction of columns and suspended slabs. CD Civil has begun works on Cudgen Road in closer proximity to receivers which includes construction of permanent footpaths, stormwater drainage adjacent to Cudgen Road, road construction and widening which includes the use of large 10T vibratory rollers, excavators, multi-tyred rollers, graders and asphalt machines.

The purpose of environmental monitoring is to:

- Assess construction related airborne noise levels against regulatory requirements, development consent conditions, Australian guidelines, and international standards for construction noise management and control on construction sites
- 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:	23/03/2022
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	<p>Construction, including the delivery of materials to and from the site, may only be carried out between the following hours:</p> <ul style="list-style-type: none"> (a) Between 7 am and 6 pm, Mondays to Fridays inclusive; and (b) Between 8 am and 1 pm, Saturdays <p>No work may be carried out on Sundays or public holidays.</p>
	C5	<p>Construction activities may be undertaken outside of the hours in condition C4 if required:</p> <ul style="list-style-type: none"> (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).

Conditions of Approval Number		Condition requirements
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 program of works, unattended noise monitoring equipment was relocated on 17 November 2022 along the southern alignment of Cudgen Road at three designated locations.

The monitoring locations were established to assess the potential noise impacts to the nearest sensitive receivers and ensure the roadworks 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 program 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

The chainage targeted for roadworks and the project site where the construction works are currently undertaken is surrounded by a number of non-residential land uses.

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

Note: 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 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 an open window for ventilation.

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 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 report covers the monitoring period of the whole calendar month of February 2023. Unattended noise monitoring is conducted at three (3) locations using Class 1 four-channel Svantek SVAN 958A 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 to prevent and avoid temperature related failures, and moisture intrusion. Images relating to the installation of the loggers is 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	Location	Serial Number	Calibrated on	Calibration Due
Svantek	SVAN958A	005	92832	01/02/2022	1/02/2024
Svantek	SVAN958A	006	92835	18/02/2022	18/02/2024
Svantek	SVAN958A	007	92834	09/03/2022	9/03/2024
Svantek	SV-33B	Calibrator	104340	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

The noise monitoring equipment continuously measures the ambient noise environment’s A-weighted Sound Pressure Level in 15-minute periods 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 the ground level. A wind shield was placed on each microphone to reduce any wind interference during the measurements.

Lendlease has established a daily checklist on site to ensure all monitors are operating in the field correctly, have adequate sunlight to power the units and that they are reporting consistently. Lendlease will report any issues immediately to ADE.

Furthermore, ADE conduct regular checks throughout the week via telemetry to ensure the monitors are operating and recording correctly. ADE are to advise Lendlease of any issues immediately. Monitors will not be removed unless consultation with Lendlease, TSA and HI have occurred and alternative locations are agreed upon.

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 loud bangs, dropping of heavy machinery, jack hammering/rock breaking, alarms etc.) would see impact at all three loggers with varying noise levels, correlated through graphical analysis.

When an event occurs, it is discarded if it cannot be demonstrated that the event occurred on Site; that is, could be observed within the data at all three locations. An event which is detected at each of the three locations can be reasonably assumed to have occurred on Site (or externally such as an emergency vehicle), and is then investigated further.

Vibration impacts can be correlated with noise impacts where large/heavy plant equipment are in use in close proximity to 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 otherwise vibration intensive plant equipment are within perceptible distances from the devices or sensitive receivers.

These impacts are less likely to occur at greater distances where vibration energy dissipates through the earth, whereas noise would dissipate at approximately 6 dB per doubling of distance in nominal conditions.

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

Weather data is collected at Coolangatta AWS (ID 040717); noise data is correlated with weather conditions and processed in accordance with the NPfl.

3.2 Results

Processed noise monitoring data demonstrates that the ambient noise environment is dominated by fauna and insects, as well as existing road traffic noise. 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.

Table 8 Unattended noise monitoring results (overall)

Logger ID	Measured noise levels, dBA												
	Average noise level (Leq)			L10,ave noise level			Background noise levels (RBL)			RNP defined noise level (Leq) ¹			
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day		Night	
										15 hr	1 hr	9 hr	1 hr
L.005	57	55	49	60	58	52	46	40	39	57	58	49	52
L.006	56	54	47	59	57	50	45	40	36	55	57	47	49
L.007	66	58	52	70	62	54	47	43	39	65	61	52	55

Note: 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 February show an increase in potential noise impacts recorded at the loggers’ locations primarily due to the road improvement works along Cudgen Road.

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

- Excavation works to full depth of pavement on Cudgen Road. Plant used in this activity include 8T excavator, Grader, 9T Roller and Bobcat. This roadworks activity was approximately 20 m from the noise monitoring locations
- Portable generators was used throughout the day for various activities. The closest activities generator was approximately 60 m from the noise monitoring locations
- Haulage/transportation associated with construction activities for spoil removal (to an assigned compound) and material delivery through main entrance of the Site was identified as a noise impact. The majority of the trucks involved were identified as semi-trailers and body trucks (ie 6-wheelers). Noise Monitoring locations were within 30 m of identified Truck movements and haul routes
- Installation of stormwater and drainage infrastructure along the southern alignment of Cudgen Road. Plant identified in this works activity include an 8T excavator and plate compactors. This construction activity was conducted in close proximity to noise monitoring equipment (approximately 5 m)

- Installation of a new watermain along the southern alignment of Cudgen Road. Plant identified in this works activity include an 8T excavator, a 5T roller and plate compactors. These works were undertaken within 15 m of the noise monitoring locations

The following graphs display measured Leq noise levels exceeding 57 dBA (to filter out low ambient noise), and are inclusive of all road traffic noise along Cudgen Road and weather affected data. Only the correlation between noise and vibration is used for conservative assessment purposes to establish the potential impact from road works near the loggers position at each monitoring location.

Figure 1 shows correlation with work activities where vibration levels are increased at Location L.005. Correlative impacts are noted on February 1-2, 9-10, and 17.

Data analysis concludes there is no immediate noise impacts during the survey period, noise level exceedances are attributed to existing road traffic noise and extraneous noise (such as fauna, environmental).

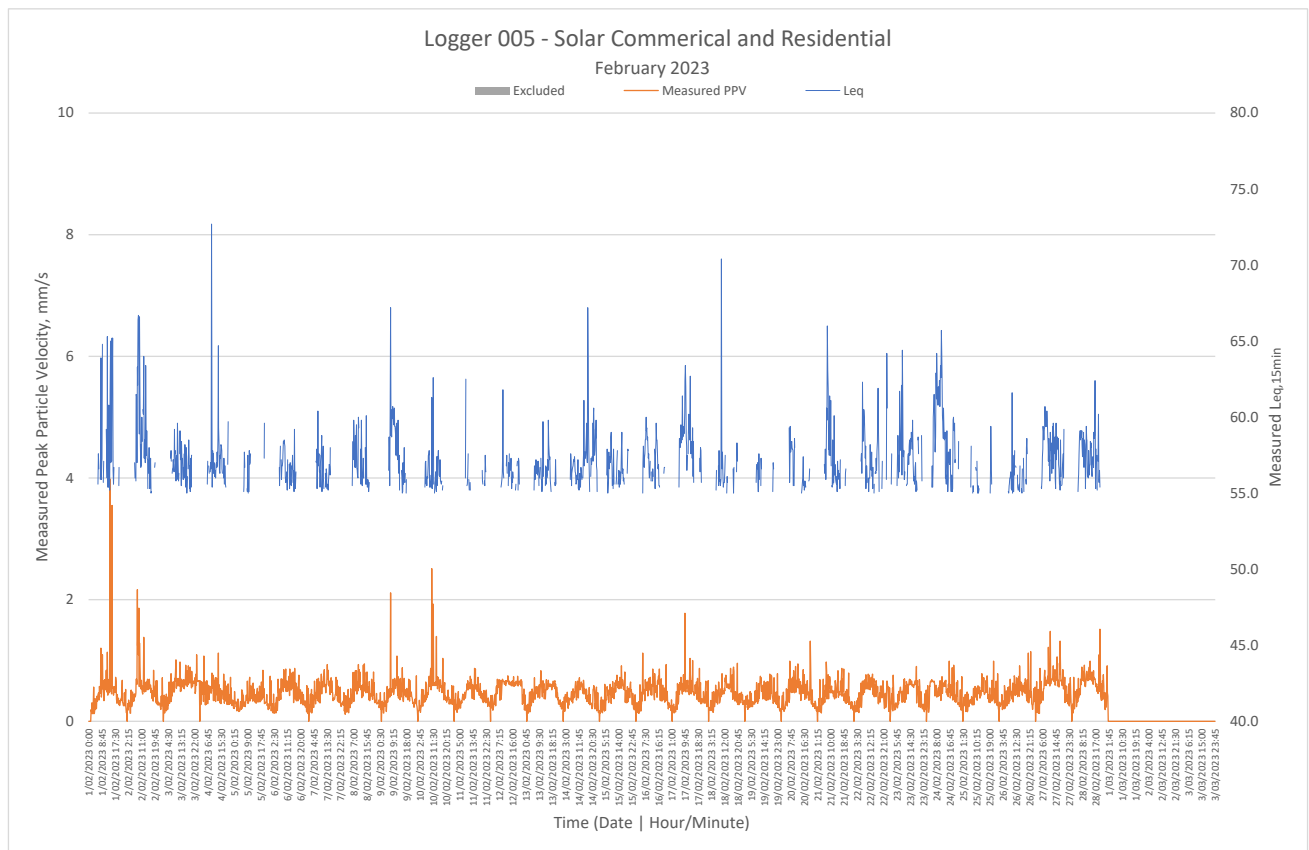


Figure 1 Measured PPV Vibration and Leq noise levels – Location 005

Figure 2 presents correlation data at Location L.006. This location has high levels of extraneous noise and vibration, potentially extraneous such as weather induced or other, as measurements were inconsistent with works on site.

It was observed that during this survey period the monitoring equipment’s ground sensor and microphone is located near by a farm where irrigation and farm equipment as well as cropping activity may have influenced readings.

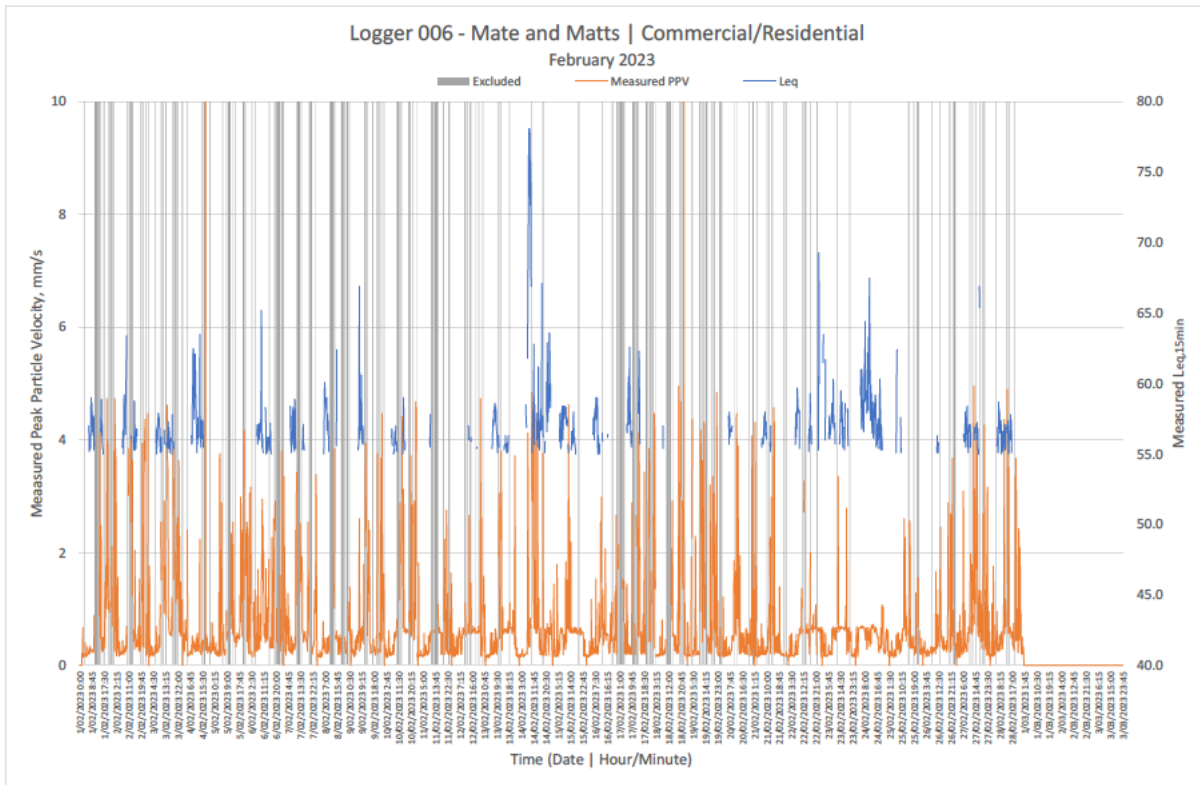


Figure 2 Measured PPV Vibration and Leq noise levels – Location 006

Figure 3 below presents correlation data collected to assess potential noise impacts or nuisance to the residential properties located in the south west of the works area . Correlated noise and vibration data is noted on February 2-3, 6-9, 14-17, 21-23, and 27-28. Assessment of the data is cautiously attributed to noise associated with trenching works which were confirmed to have occurred near to the monitors location.

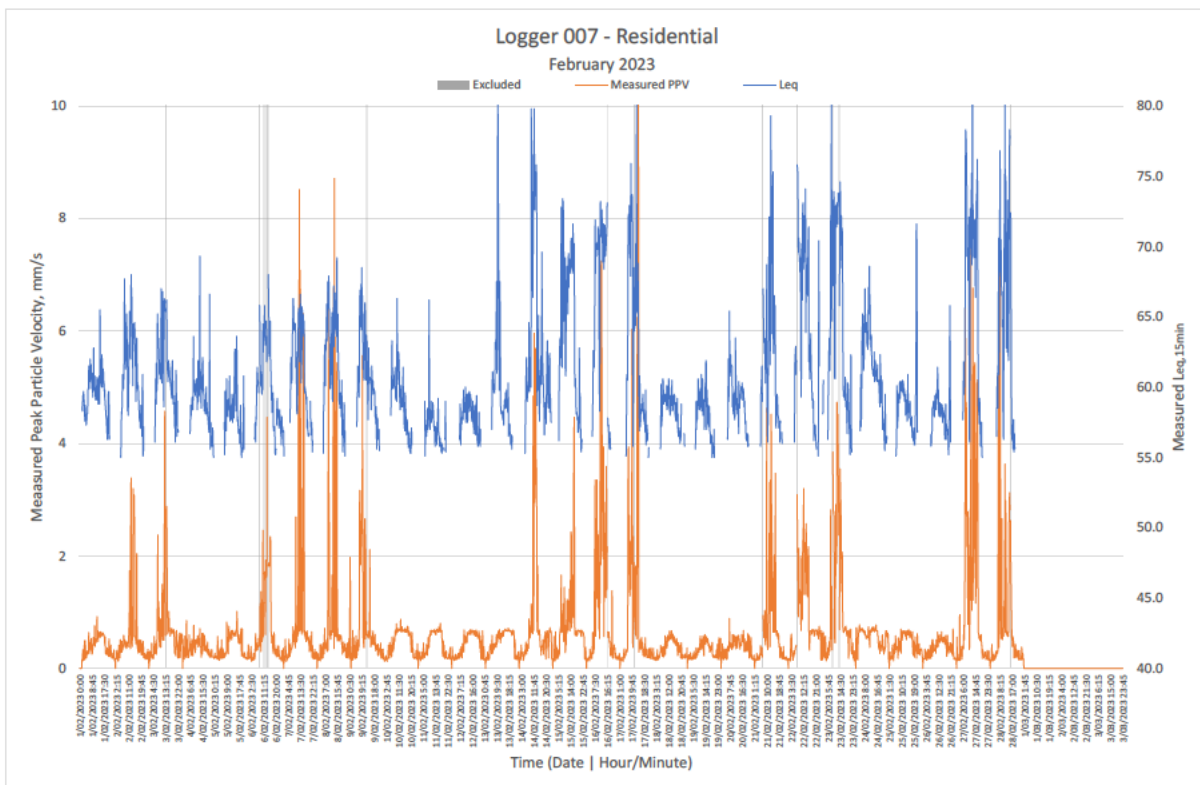


Figure 3 Measured PPV Vibration and Leq noise levels – Location 007

3.3 Discussion

During the calendar month of February 2023, the meteorological conditions exhibited above average wind conditions and increased precipitation resulting in 16 days (whole or part). This extraneous weather (period of wind greater than 5m/s and rain) was noted during the measurement period and data affected by these extraneous weather events were filtered to remove this from the analysis undertaken to eliminate bias. This is in line with acceptable analysis and reporting exclusion requirements as set out in the NPfI.

Noise contribution from roadworks has shown an increase in noise levels (ie identified ambient noise and construction noise from the Site) within the works area as excavation works and plant usage increases.

The measured noise levels are comparative to the predicted noise levels outlined in the ADE CNVIS for the anticipated works as the loggers are positioned closer to the active work fronts than the facade of the impacted receivers. Noise graphs for each of the noise monitoring locations are presented in **Appendix V – Noise Graphs**.

Noise levels were higher than the previous monitoring period (January 2023), as vibration intensive and noise intensive (such as rolling works) activities were undertaken with increased frequency. Traffic levels from construction is judged to not have increased by any significant level as the measurement analysis covered in this report is less than the predicted level (57 dBA $Leq,9hr$) outlined in the CNVIS.

The noise management practices outlined in both the Management Plan, and the CNVIS prepared for CD Civil are to be employed at all times. Where any one (1) valid complaint is received, in consultation a range of recommended management and mitigation measures should be employed to minimise the identified noise impacts where feasible and reasonable.

3.3.1 NML exceedances

Construction activities and roadworks occurring in close proximity to the noise logging devices recorded noise levels exceeding the noise management levels at the devices location. The NML exceedances and measured noise levels recorded during the February survey period are within the predicted noise results of the CNVIS (**Section 5.2.4**)

Some intermittent higher noise levels have been identified as being associated with trenching activities within the road construction area whereby results recorded are higher than anticipated on several occasions.

The data recorded shows intermittent use of generators, trucks, excavators, graders, and bobcats in close proximity to the noise monitoring devices across the work area within the road corridor. Recorded data shows noise levels increase up to a maximum 84 dBA Leq (Highly Noise Affected) on one occasion (28 February 15:30 hrs) for a short duration and though not confirmed at time of writing may be associated with large plant operating adjacent to the monitoring location.

Analysis of the data from Logger L.007 shows that some vibration intensive plant (such as vibratory rollers, loaded trucks and excavators) were active generating noise on the following five (5) work periods over February 2-3, 6-9, 14-17, 21-23, and 27-28.

The measured results are in some cases higher than expected (note that the CNVIS does not take into account any mitigating measures) and additional mitigation measures may be necessary.

Highly Noise Affected (HNA) criteria was exceeded at least once over identified six (6) days:

- Monday 13: 82 dBA Leq
- Tuesday 14: 80 dBA Leq
- Friday 17: 83 dBA Leq
- Tuesday 21: 79 dBA Leq
- Monday 27: 79 dBA Leq

- Tuesday 28: 84 dBA Leq

An additional four (4) days (February 15-16, 22-23) where high noise levels are attributed to intermittent works. However works on February 22 and 23 were subject to adverse weather conditions and recorded measurements are excluded from the overall analysis.

The mitigation measures and management practices outlined in the CNVIS are recommended to be adhered to at all times where feasible and reasonable. When identified through the project's community/stakeholder complaint process, where applicable additional measures where feasible and reasonable should be applied.

3.3.2 Recommendations

Upon review of the data collected and the subsequent analysis, additional mitigation measures are required during trenching activities, based on the data collected and analysed throughout this report.

On six different occasions, noise levels exceeding 75 dBA Leq have been measured at Location 007. It has been identified during this survey period that trenching works and road pavement activities were undertaken in close proximity to this monitoring location.

In accordance with the Additional Mitigation Measures outlined by Health Infrastructures' Out of Hours Protocol (which includes standard hours mitigation), Letterbox Drops and Monitoring is required to address concerns of sensitive receivers nearby of potentially high noise activity.

In accordance with the monitoring requirements outlined in the CNVIS, operator attended monitoring location(s) are to be assigned to the most impacted property boundary during high noise intensive activity such as trenching works (if not complete) during standard hours, and, during out of hours, where applicable.

In addition to the Monitoring Program outlined in the CNVIS, and the CNVMP prepared by LendLease:

- Operator Attended Noise Monitoring per the NPfl and Australian Standard AS1055:2018 should be implemented:
 - Modifications per the NPfl (**Table C1**) are applicable
 - Where programmed works is undertaken during the most sensitive period where construction activity is occurring in order to provide a rapid and proactive response by the contractor
 - Where works undertaken during the same activity at the same intensity and location (if applicable and able) as historical noise exceedances have been recorded
- Where noise measurement exceeds 75 dBA Leq,15min the contractor to hold works until reasonable and feasible mitigation measures are implemented. 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 strategies applied:
 - Noise measurements conducted post-implementation to compare noise levels
 - Appraisal and adjustment of mitigation measures during works as necessary w and appropriate
- 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
 - Where boundary of sensitive land use not available and alternate locations selected in consultation or in response to construction needs, justification must be provided
 - Weather affected data removed, and/or, contributing noise sources outside the work zone to be considered or removed dependent of identifying the activity and noise source. monitoring in clear conditions

4 Conclusion

ADE Consulting Group Pty Ltd (ADE) was commissioned by Lendlease Group (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 February 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 (February 2023), CD Civil are on site undertaking associated roadworks that form part of the Tweed Valley Hospital development

- Noise Management Level exceedances (exclusive of existing traffic noise) have been identified with works associated with plant used in construction activity for the Cudgen Road and intersection upgrade
 - Some intermittent noise impacts up to 84 dBA $L_{eq,15min}$ were identified and upon review of the works program with on-site observations are determined to be associated with trenching works as much of the drainage and stormwater work has been conducted within close proximity to location L.007
- On six different days exceedances ranging from 79 dBA L_{eq} (21/02/23) to 84 dBA L_{eq} (28/02/23) exceeding the Highly Noise Affected noise criteria of 75 dBA L_{eq} . Review of the programmable works and on-site observation determined that these exceedances were primarily due to trenching activity and plant movement being conducted as close as 5 m from location L.007
- Noise levels measured at locations L.005 and L.006 exhibit a typical ambient noise environment dominated by road traffic noise along Cudgen Road, and, local fauna (such as birds and insects). No impacts of concern were identified at these two locations during February 2023.

The CNVIS presents mitigations and management practices where implemented (where feasible and reasonable) are anticipated to lower the impact of the works. Upon review and analysis, the noise levels (and vibration where correlation exists) presented in this report (**NMA43**) demonstrate effective noise management practice has been implemented by CD Civil where identified.

The following 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
- To fully ascertain the potential impacts from trenching activity, Operator Attended Noise Monitoring is required prior to additional trenching works at the boundary of the most impacted residential receiver
- Detail relating to these and other previously mentioned recommendations has been provided in **Section 3.3.2**.

Appendix I – Glossary

1 Sound Pressure Level

Defined as:

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

In the above equation, p is the sound pressure fluctuation relative to atmospheric pressure, and *p_{ref}* is 20 microPascals (2 x 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 Displacement

The change in position of an object, is a vector quantity. (Stress indicator).

9 Velocity

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

10 Acceleration

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

11 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.

12 Hertz

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

13 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.

14 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.

- 15 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.
- 16 Peak**
The peak is the maximum amplitude during a measurement period.
- 17 Peak to Peak P-P**
The peak-to-peak (P-P) is the difference between the maximum positive and maximum negative amplitudes of a waveform.
- 18 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.
- 19 Zero Crossing Frequency**
Determining the apparent dominate frequency of a given sample can be achieved by using the Zero Crossing Frequency.
- 20 Primary Waves P Waves**
Alternating compressions ('pushes') and dilations ('pulls') in the same direction as the wave is propagating. P waves are the first arriving energy, smaller and higher frequency than S waves.
- 21 Secondary Waves S Waves**
Alternating transverse motions perpendicular to the direction of propagation. Slower than P waves.
- 22 Rayleigh Waves R Waves**
Motion is both in the direction of propagation and perpendicular (in a vertical plane). R waves are also dispersive, and amplitudes decrease with depth.
- 23 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'.
- 24 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.
- 25 Filter**
A device for separating components of a signal on the basis of their frequency. It allows components in one or more frequency bands to pass relatively unattenuated, and it attenuates components in other frequency bands. Modifies the frequency spectrum of a signal usually while it is in electrical form.
- 26 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.
- 27 Long-term vibration**
All types of vibration not covered by the definition of 'short-term vibration
- 28 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.
- 29 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.
- 30 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)
- 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 09/02/2023

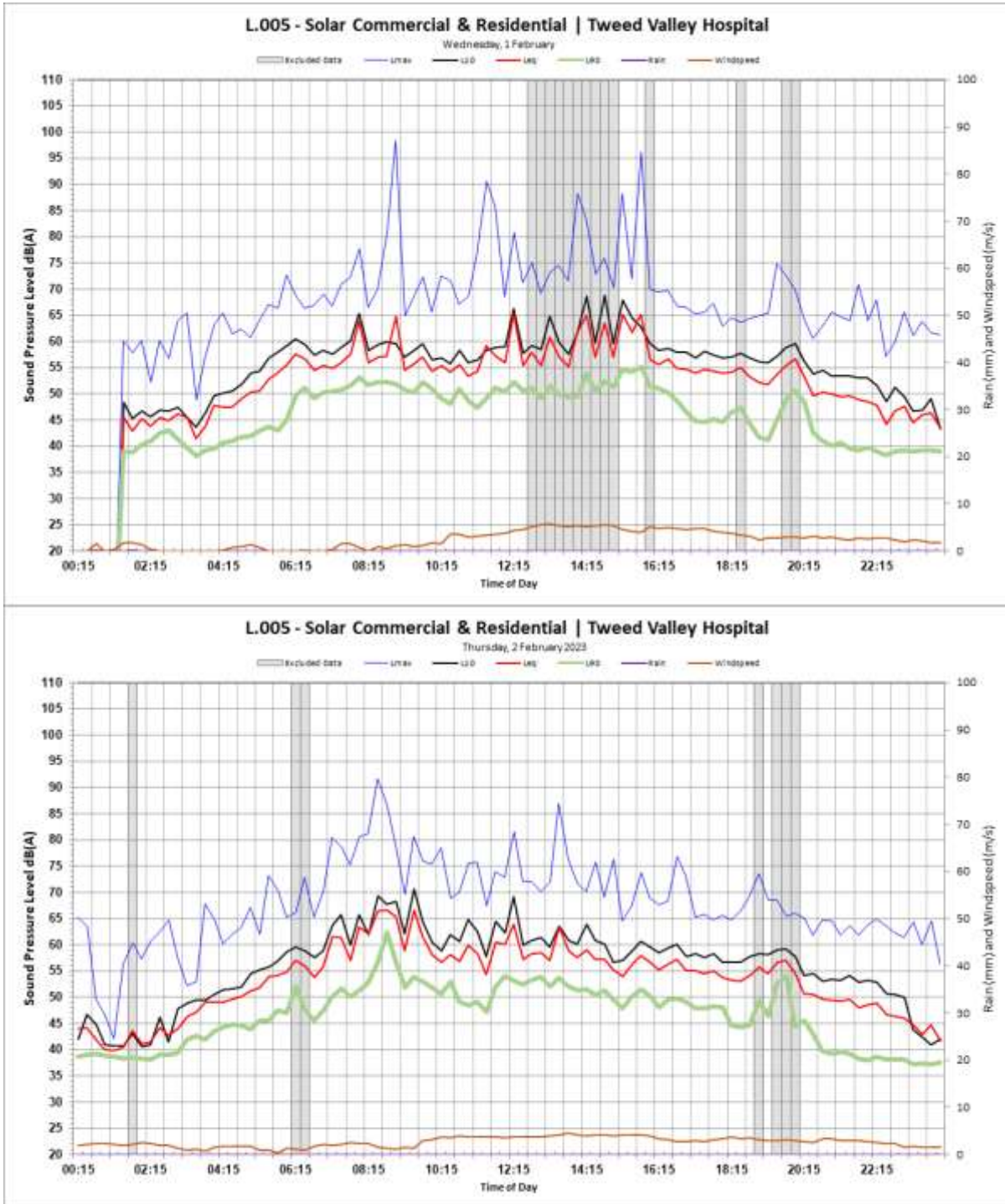


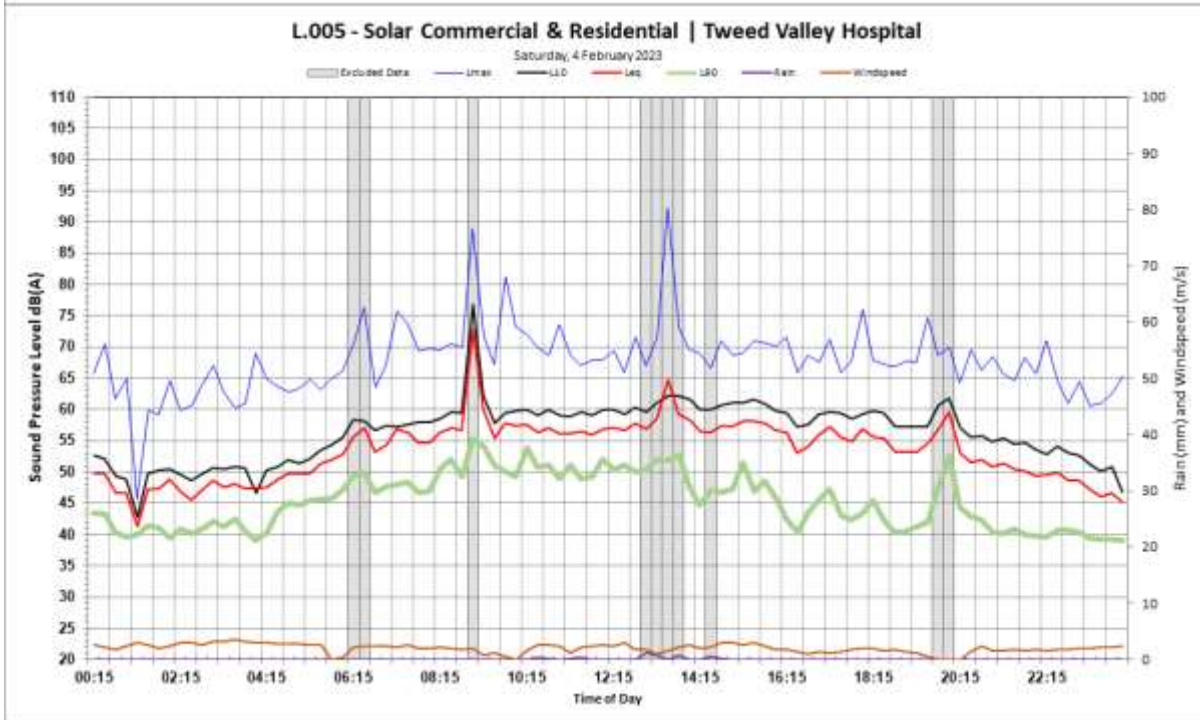
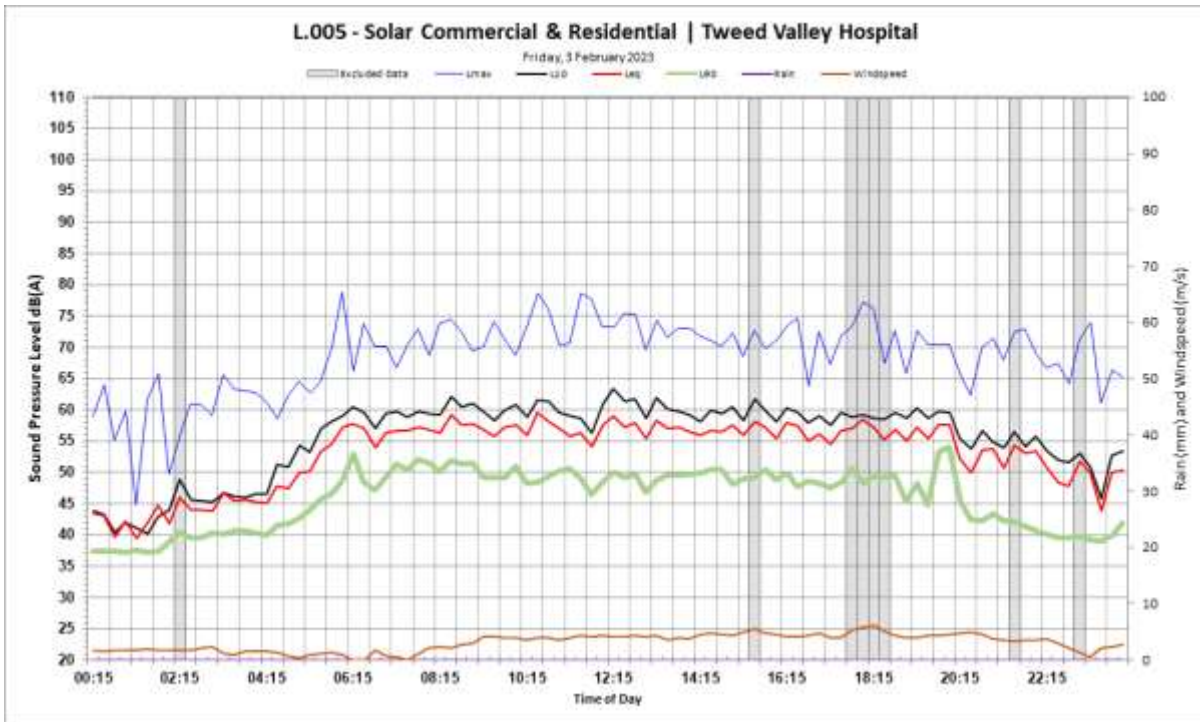
Photograph 2 Representative photograph of monitoring location 005 – Solar Industry, as observed 09/02/2023

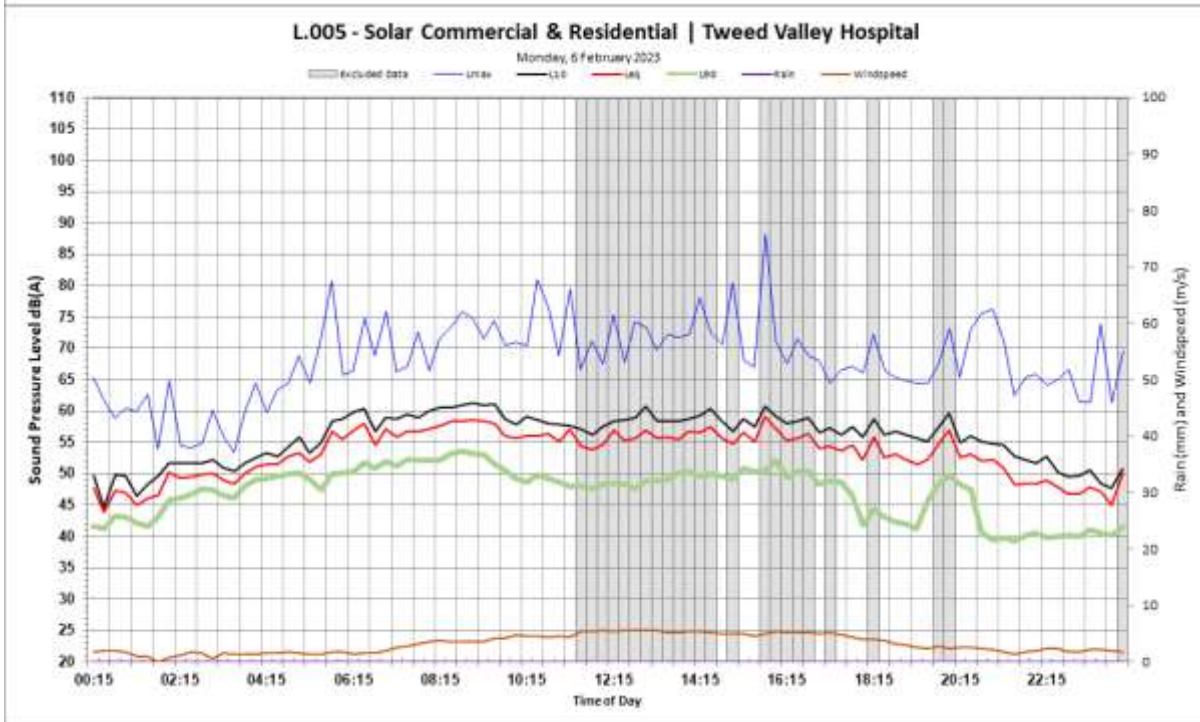
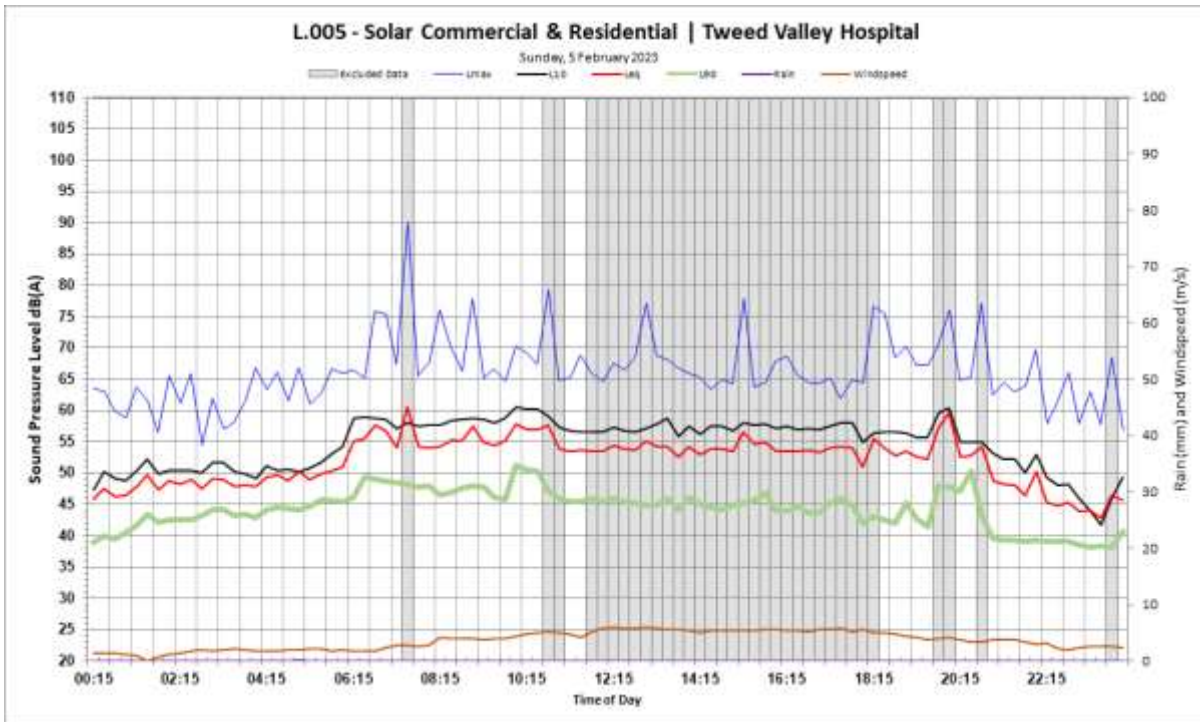


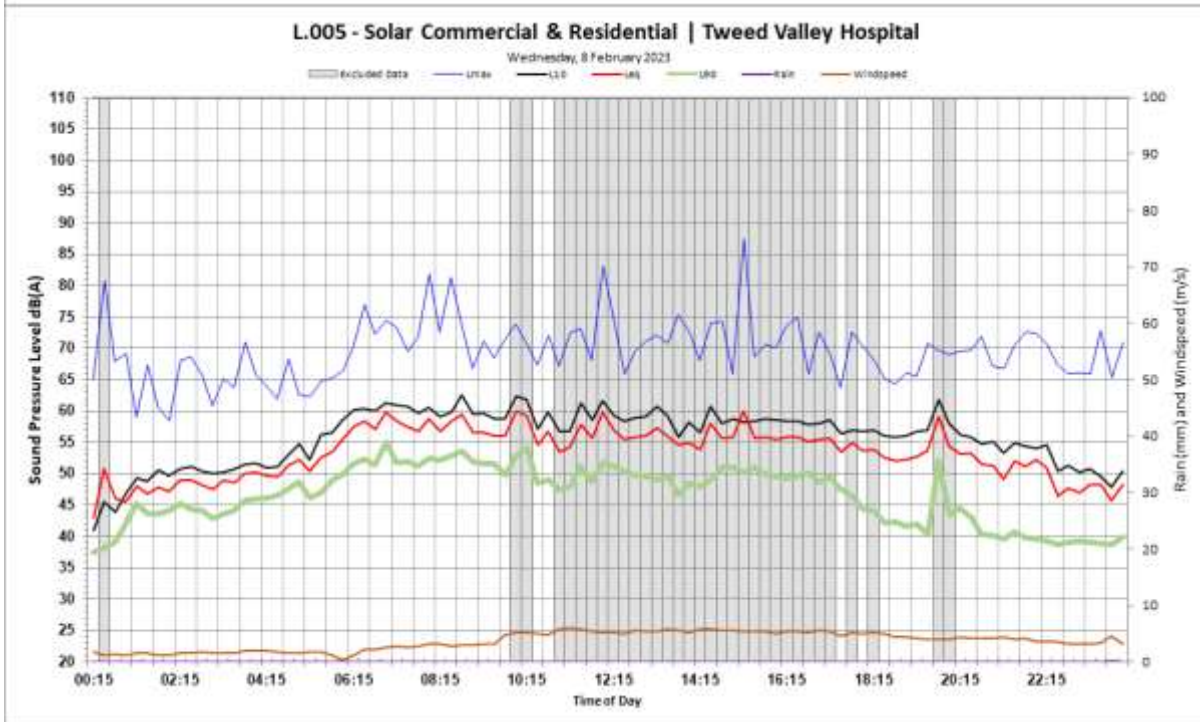
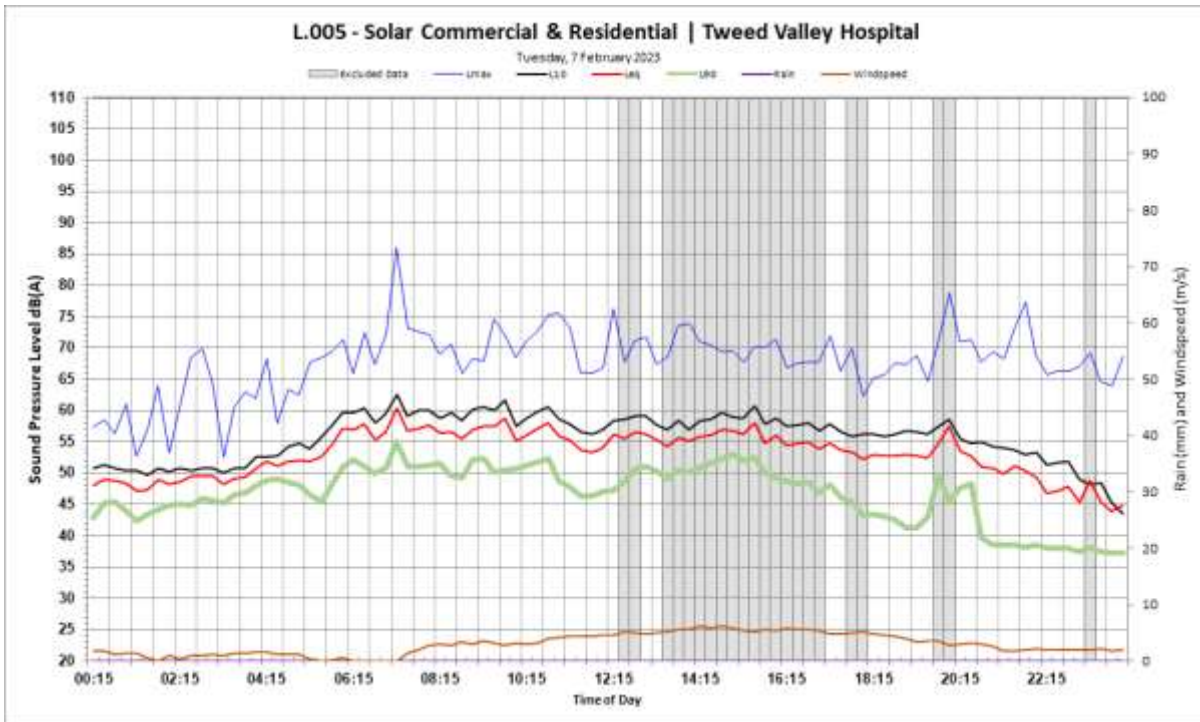
Photograph 3 Representative photograph of monitoring location 006 – Mate and Matts, as observed 09/02/2023

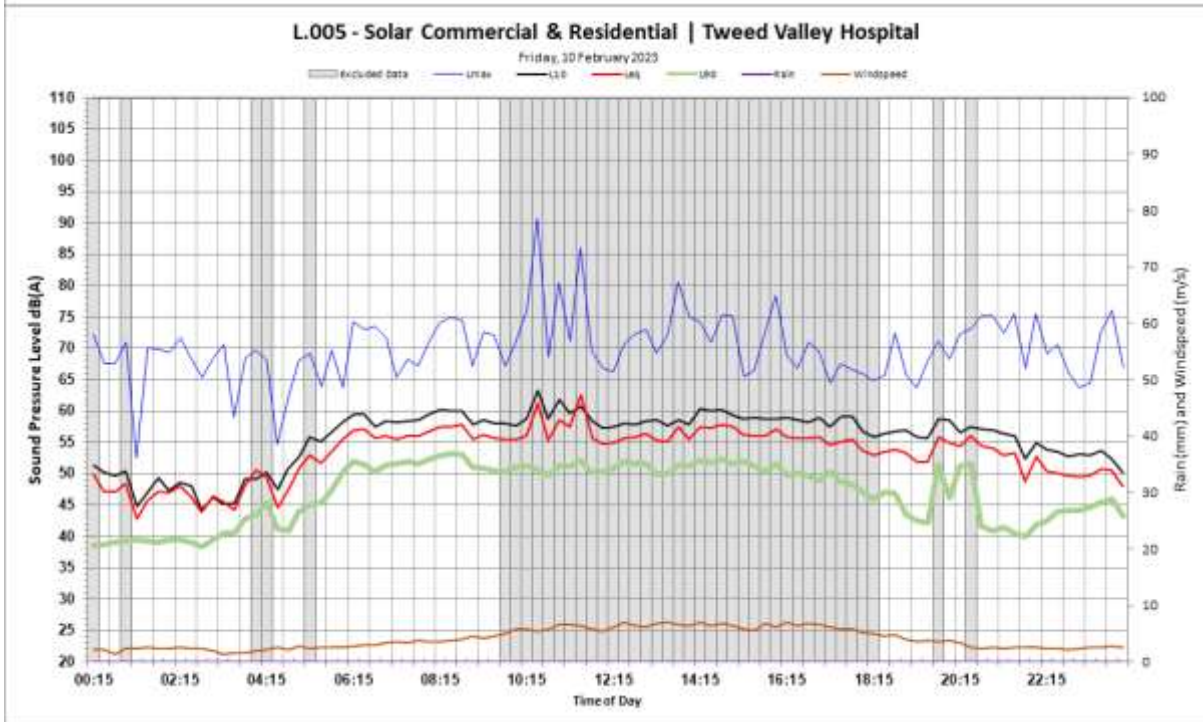
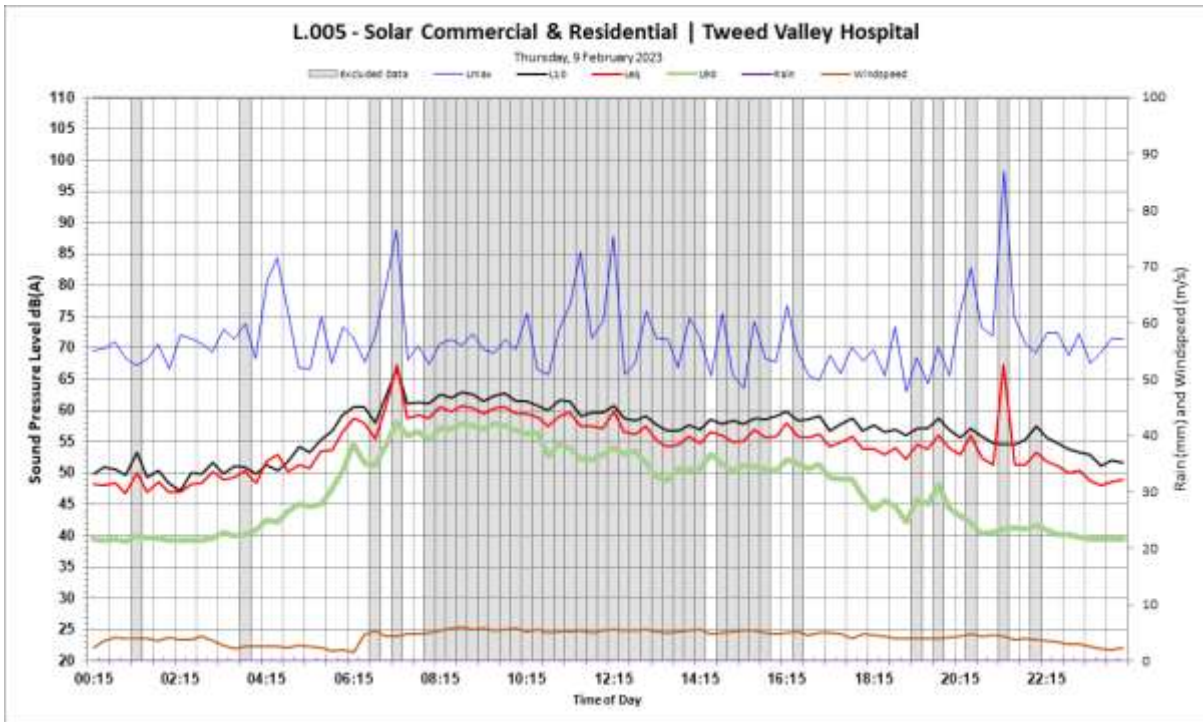
Appendix V – Noise Graphs

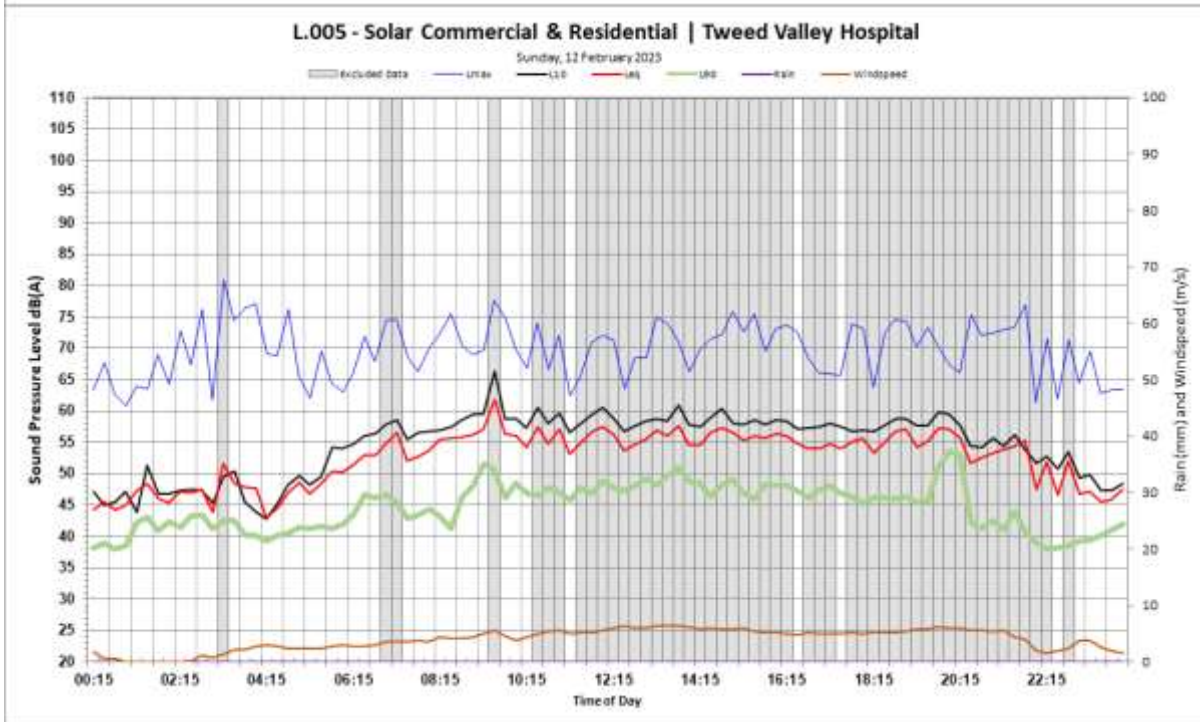
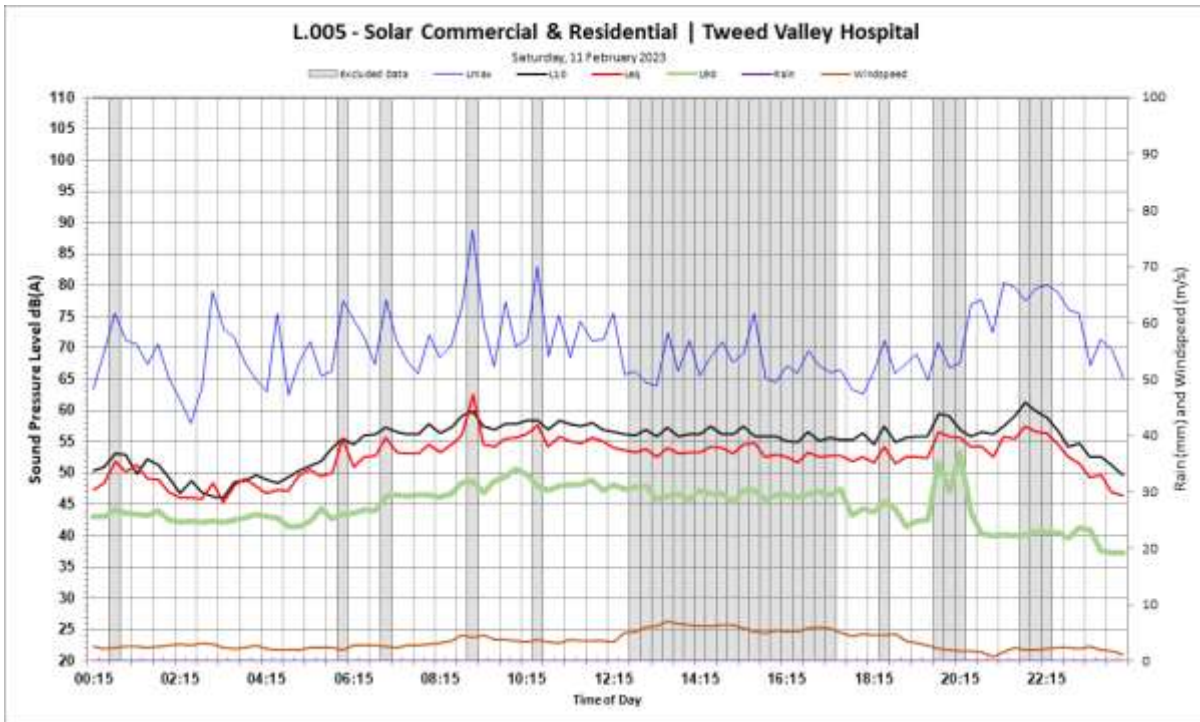


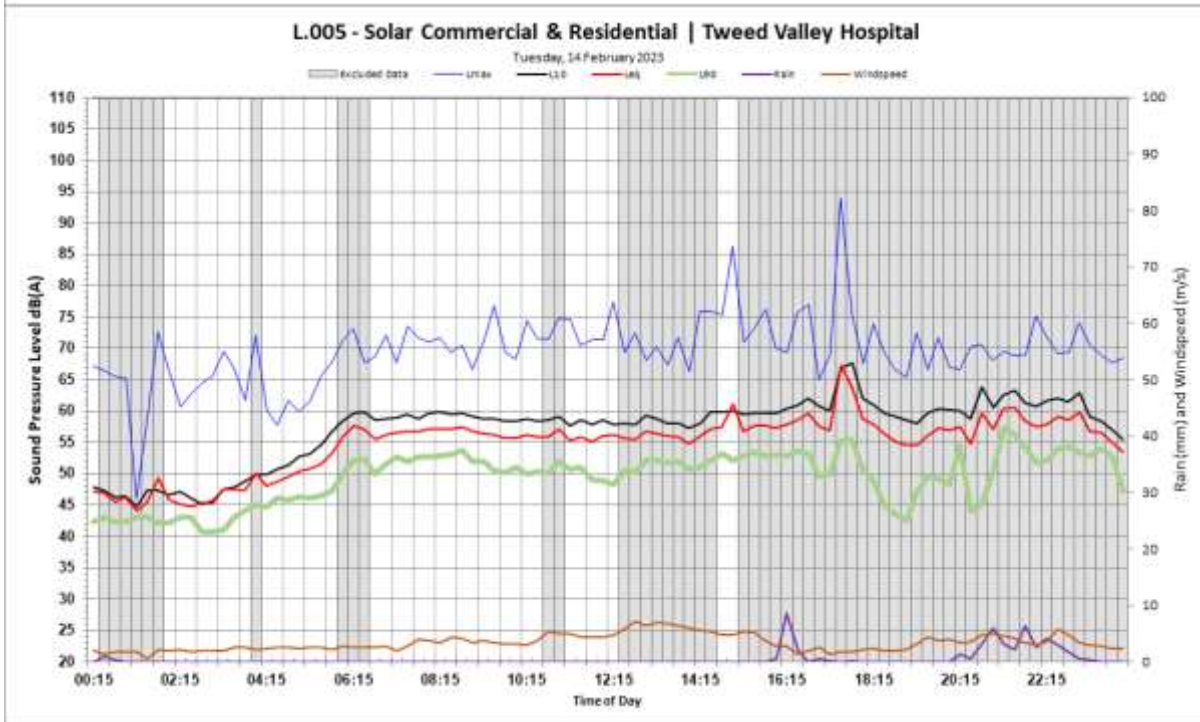
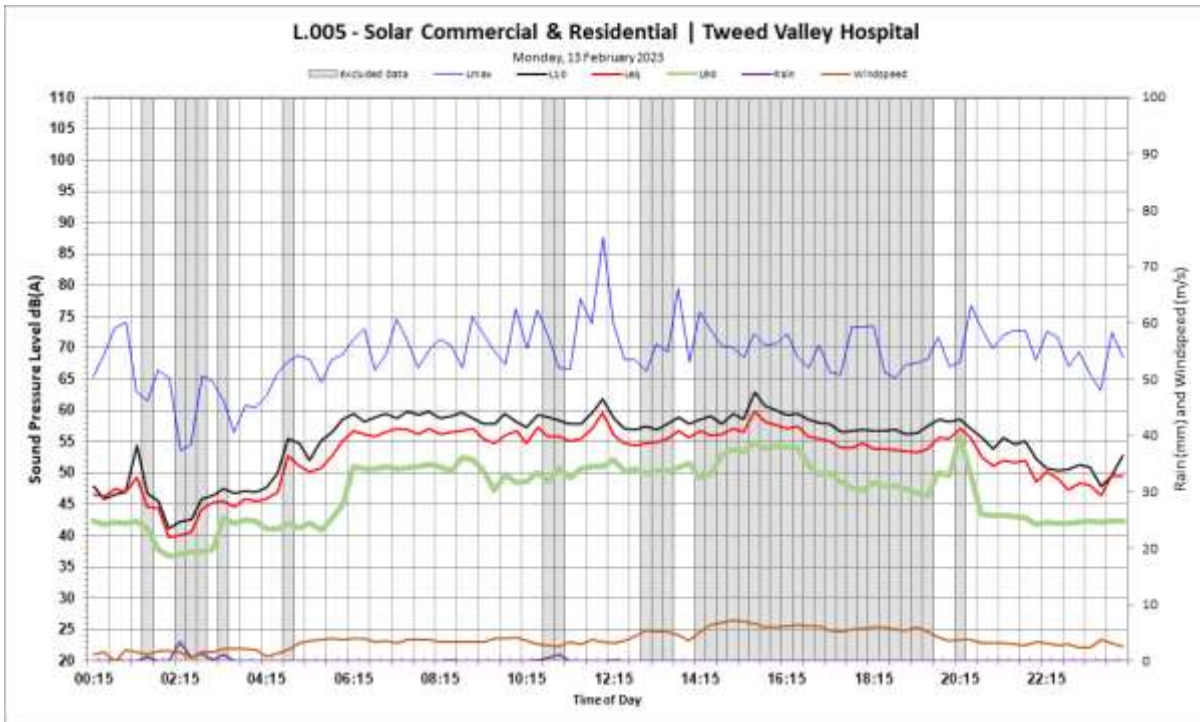






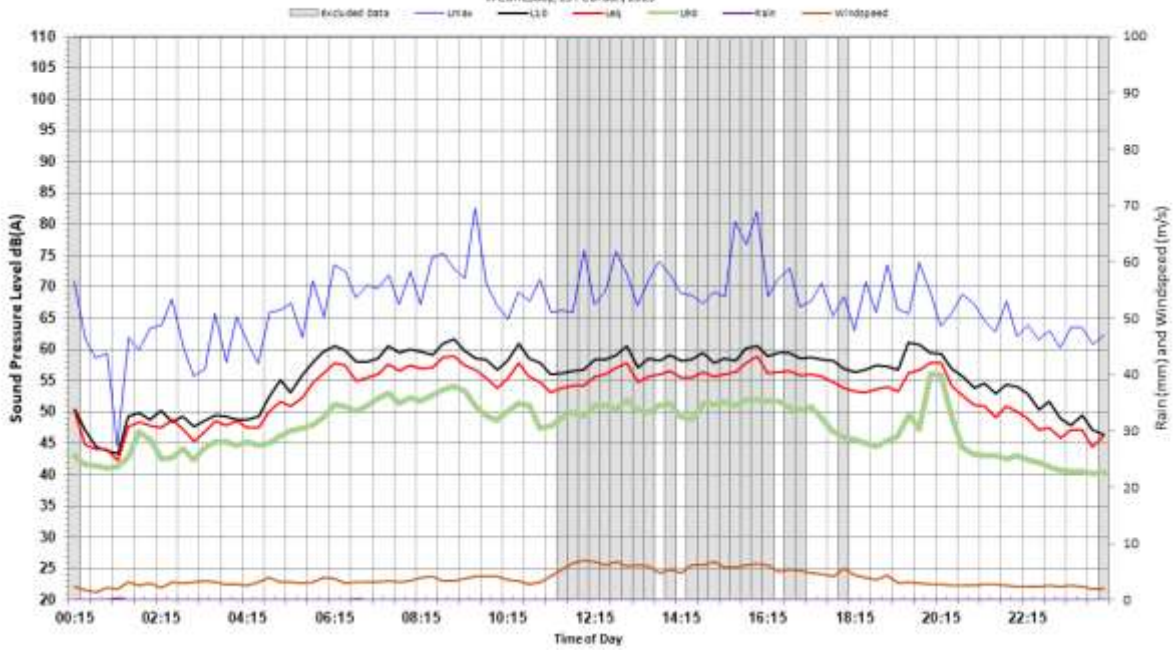






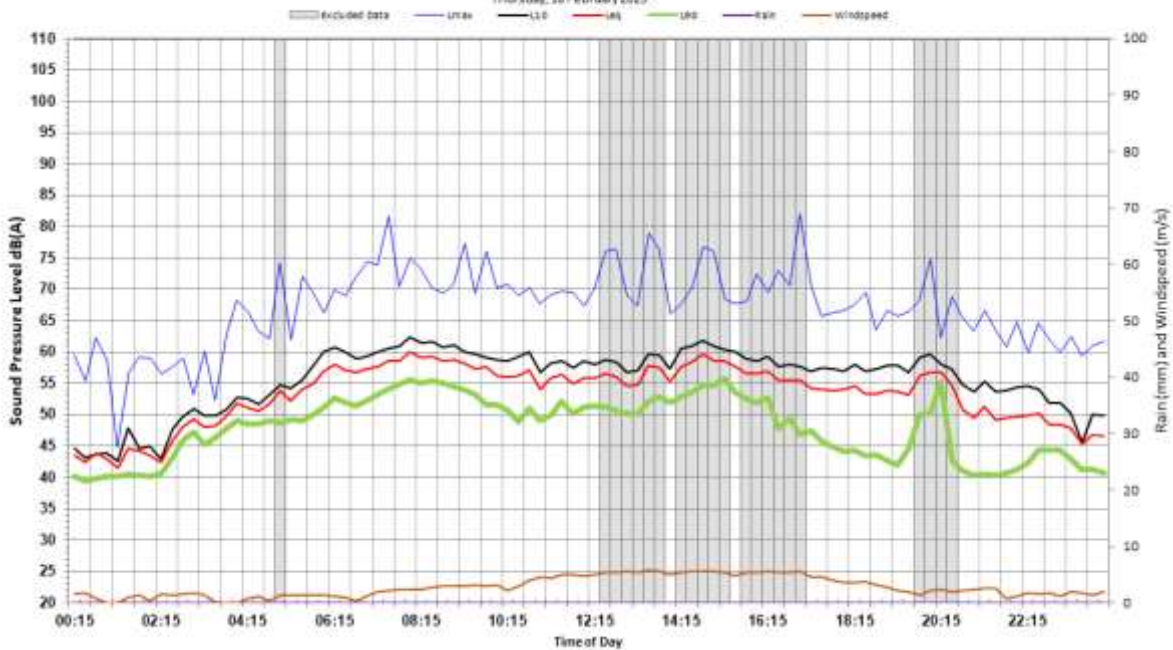
L.005 - Solar Commercial & Residential | Tweed Valley Hospital

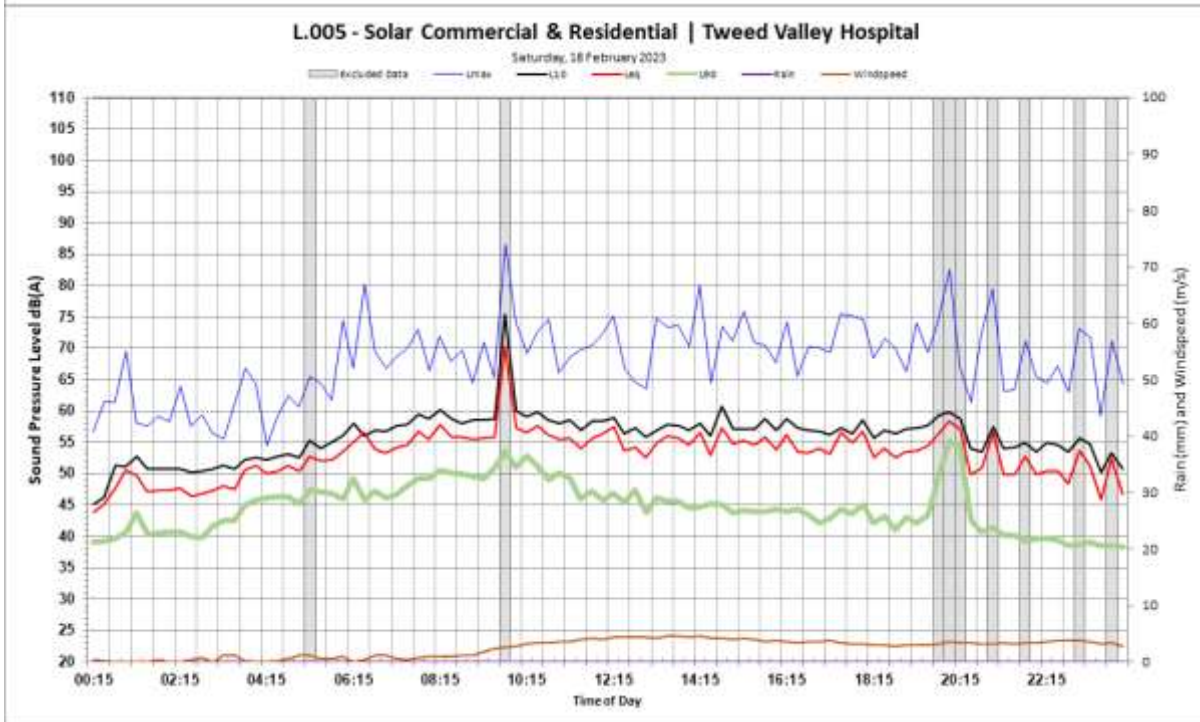
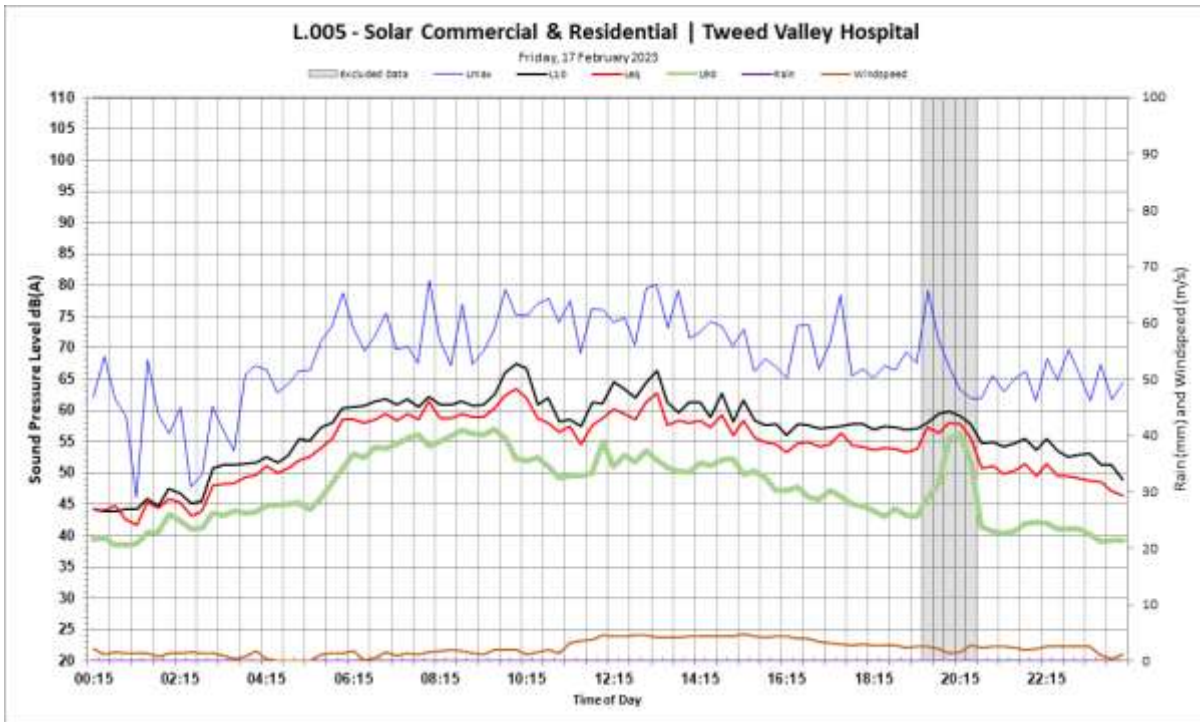
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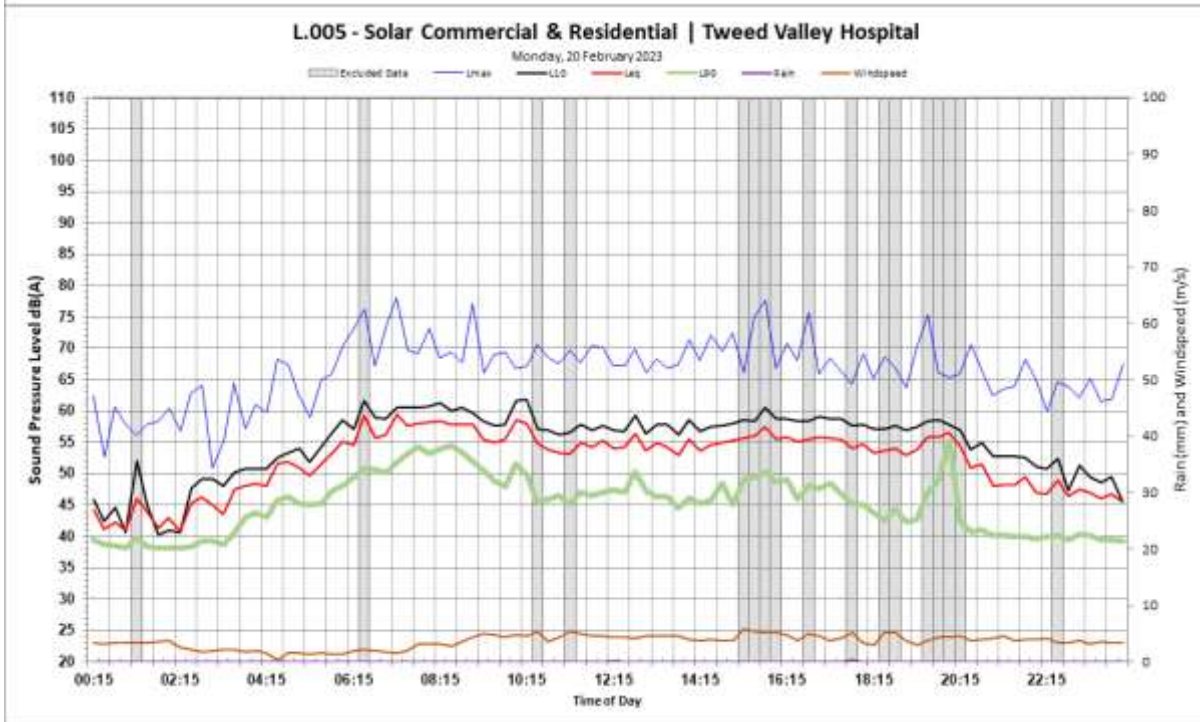
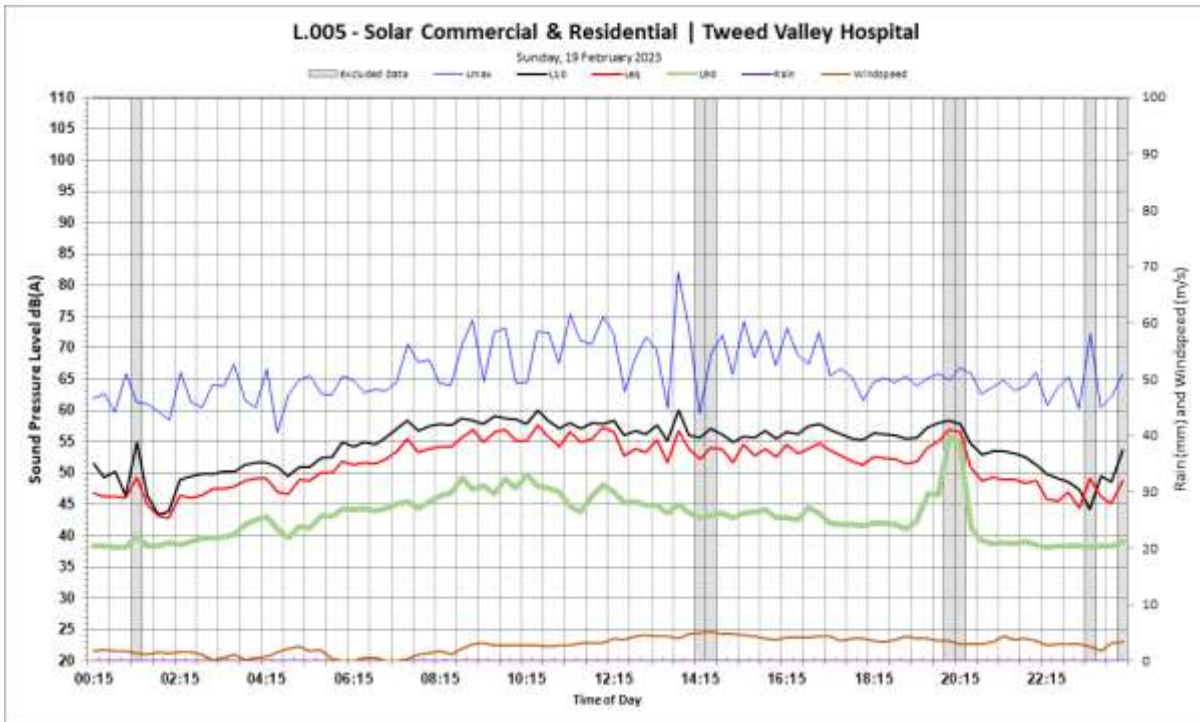


L.005 - Solar Commercial & Residential | Tweed Valley Hospital

Thursday, 16 February 2023







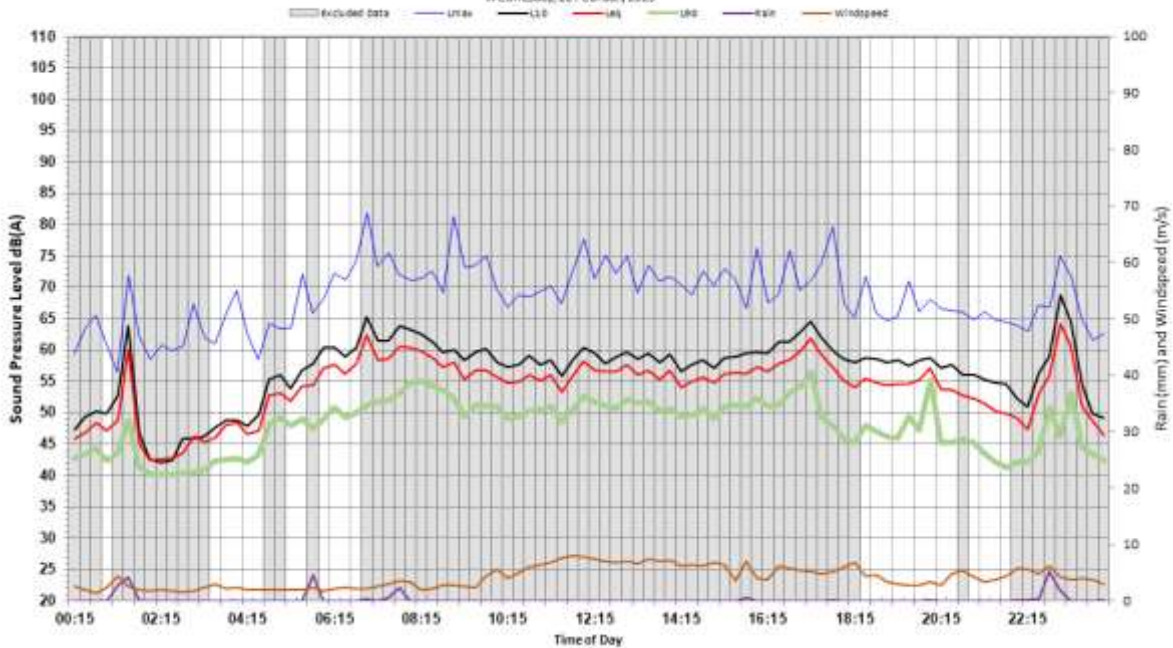
L.005 - Solar Commercial & Residential | Tweed Valley Hospital

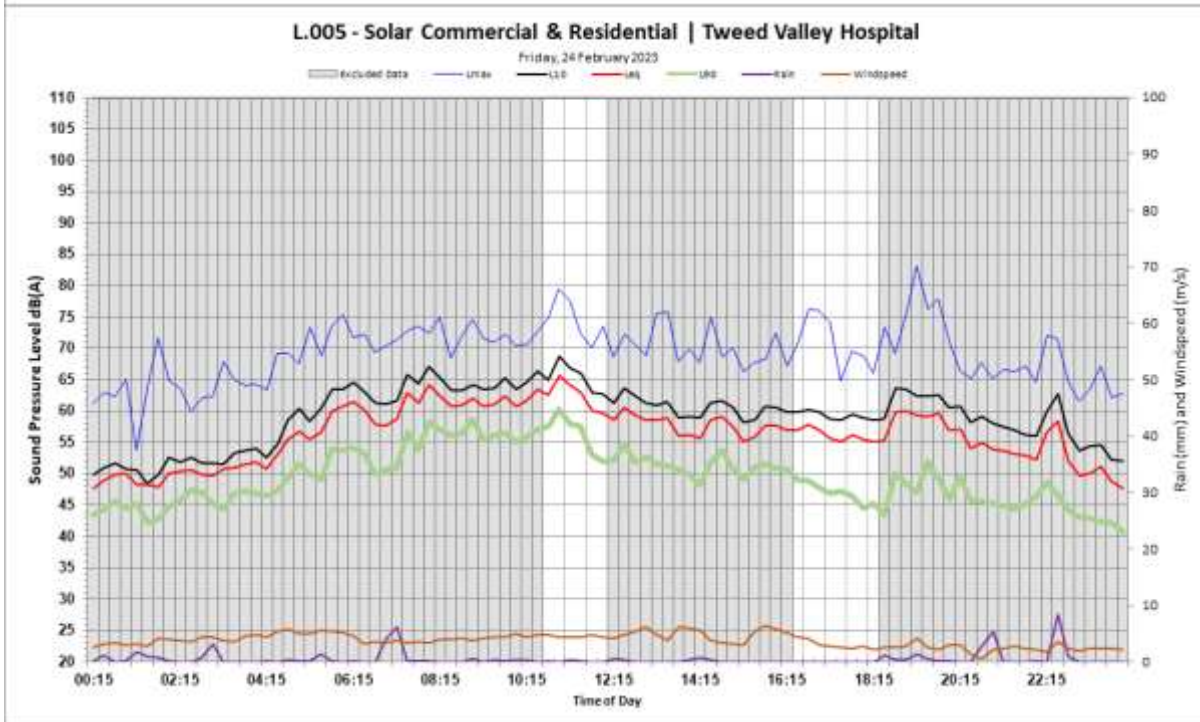
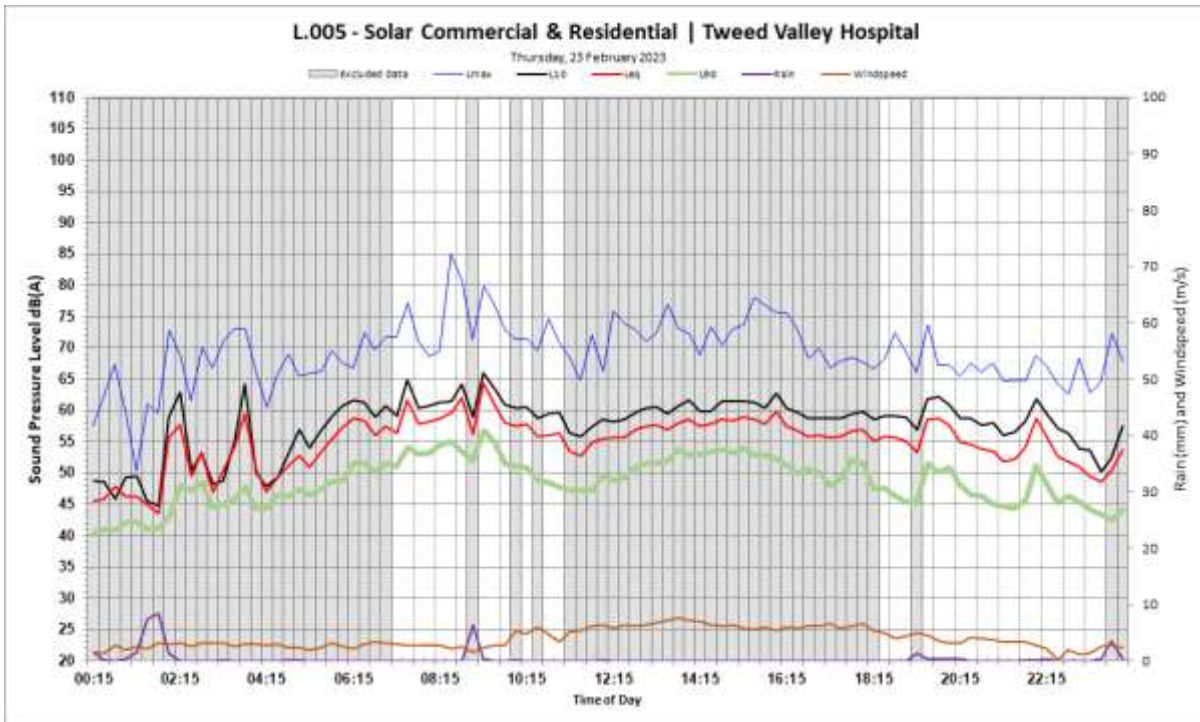
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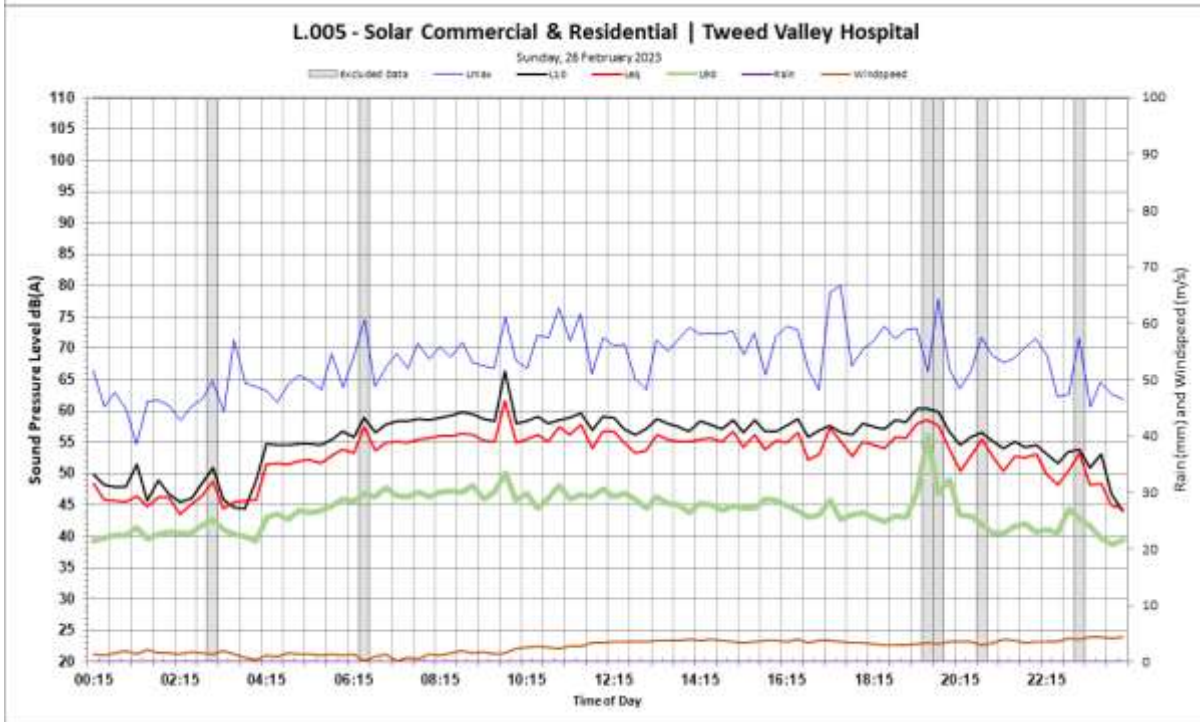
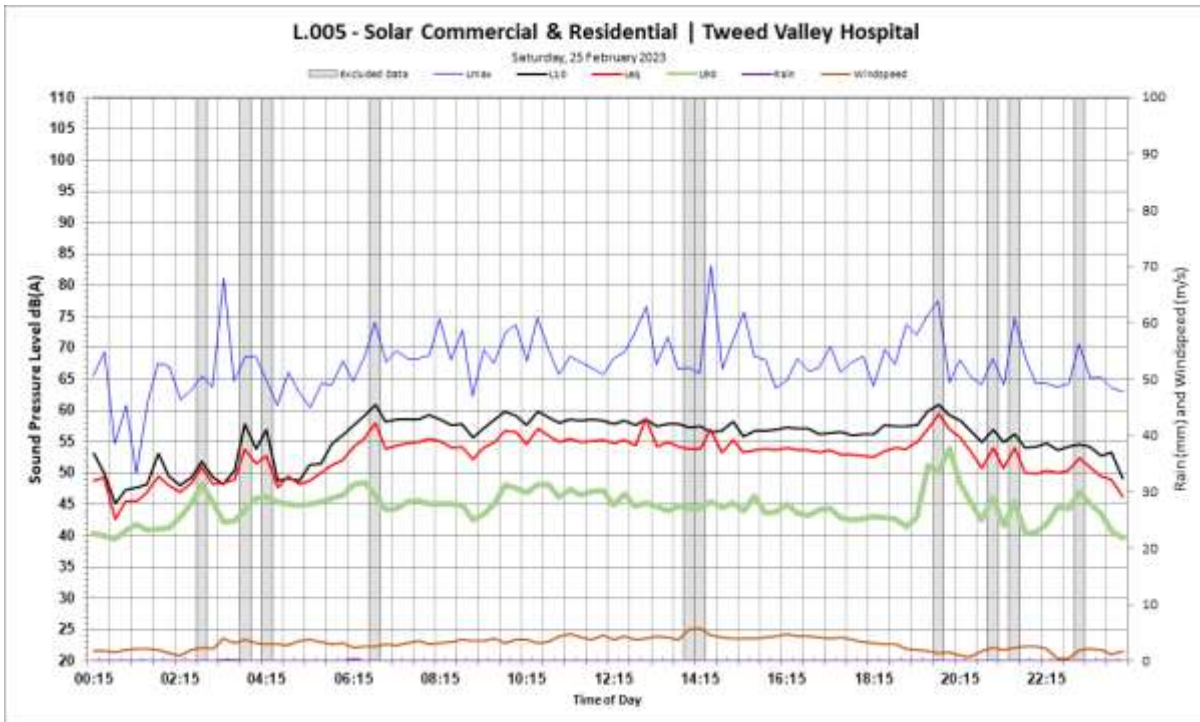


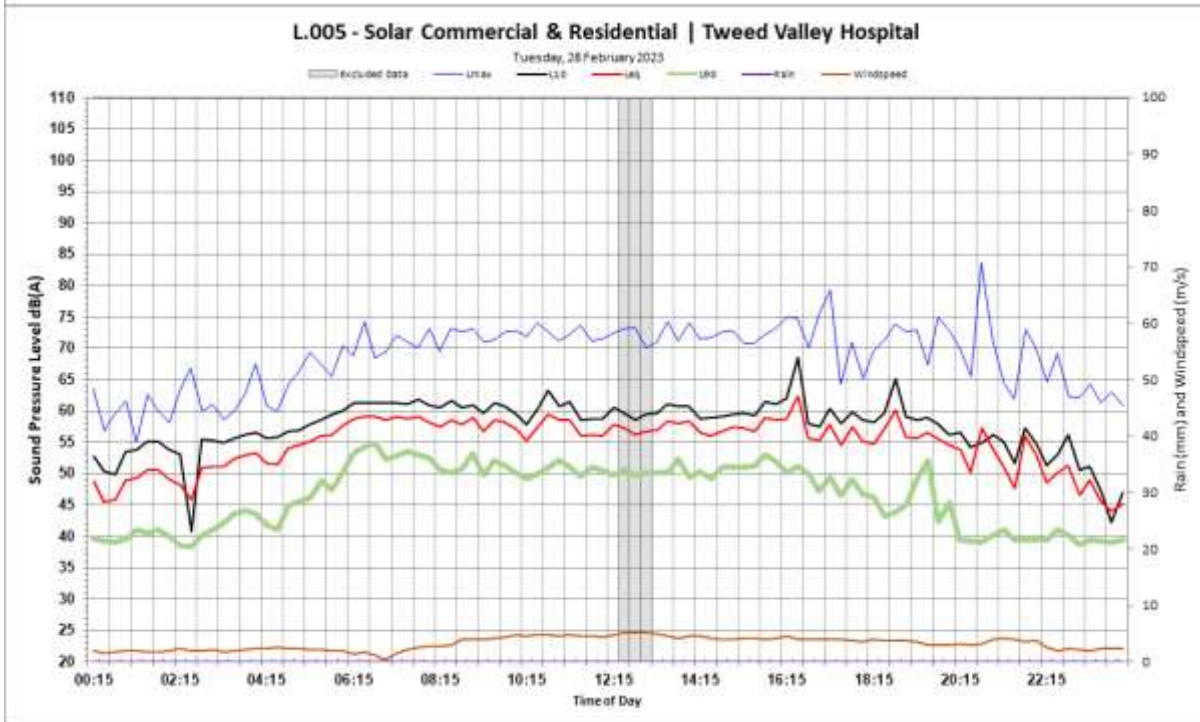
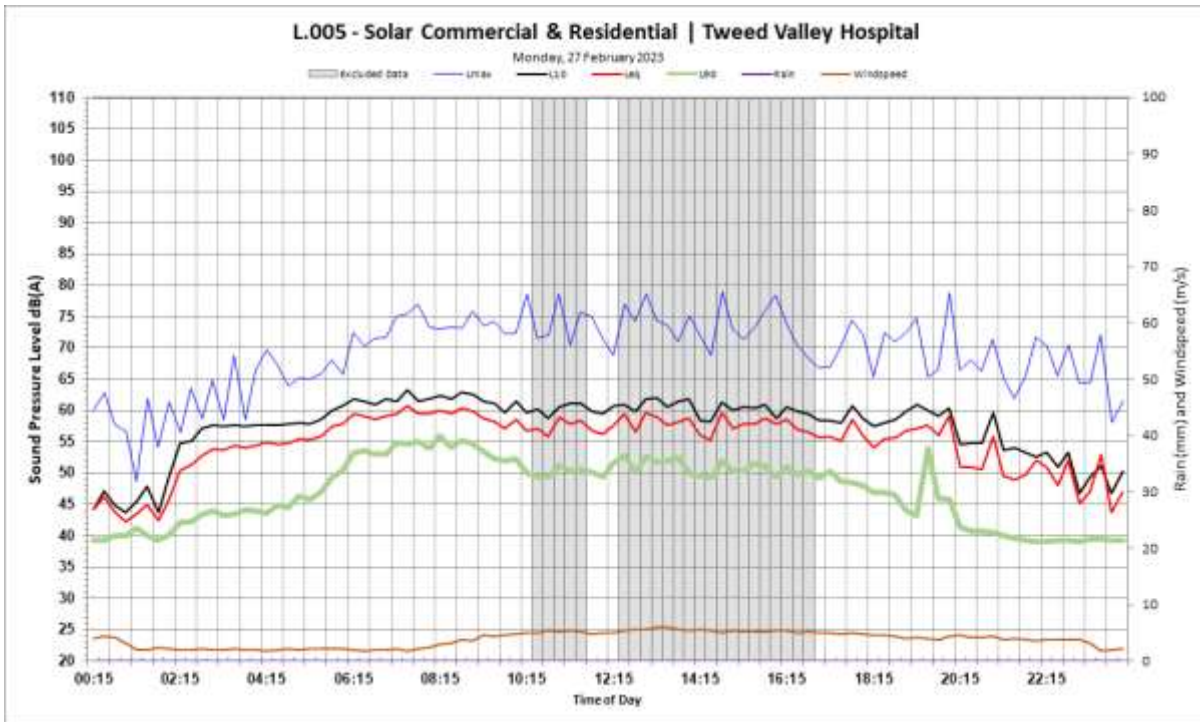
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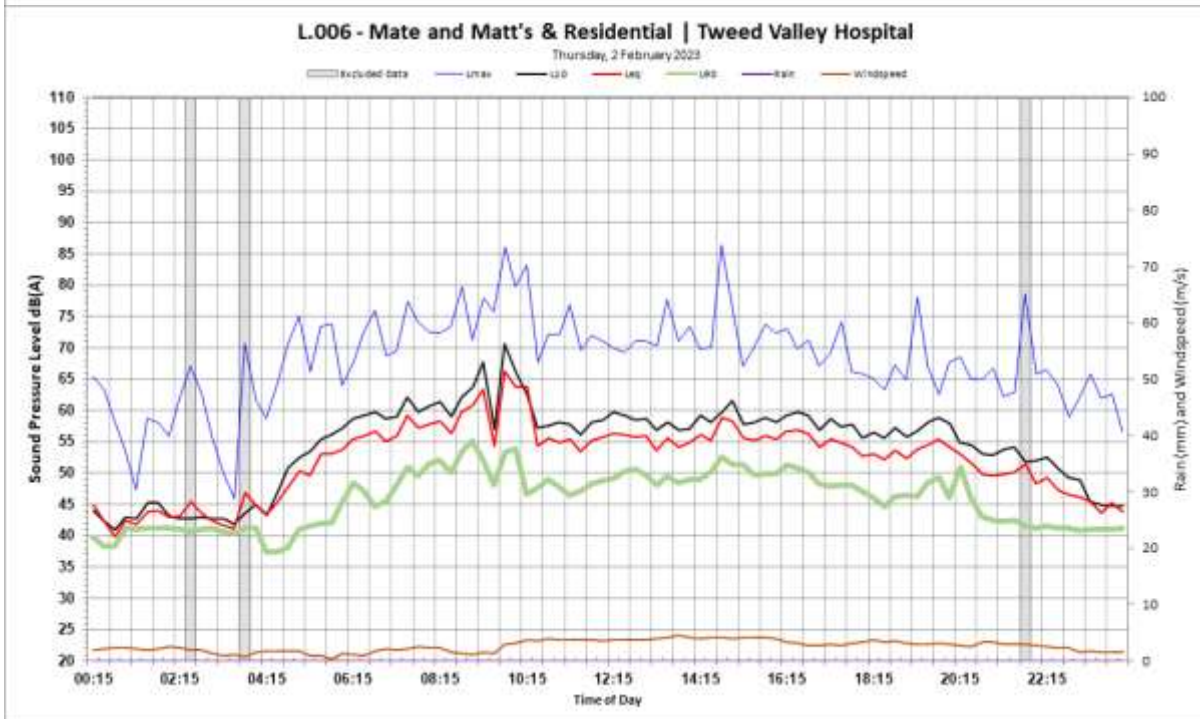
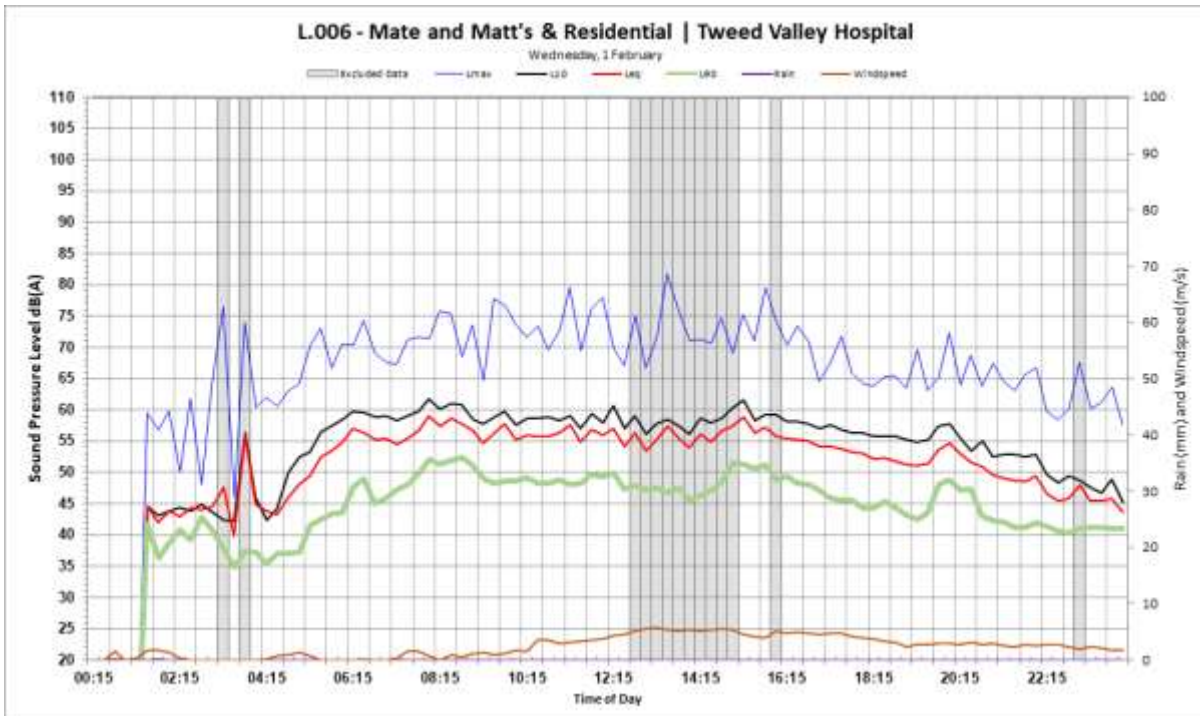
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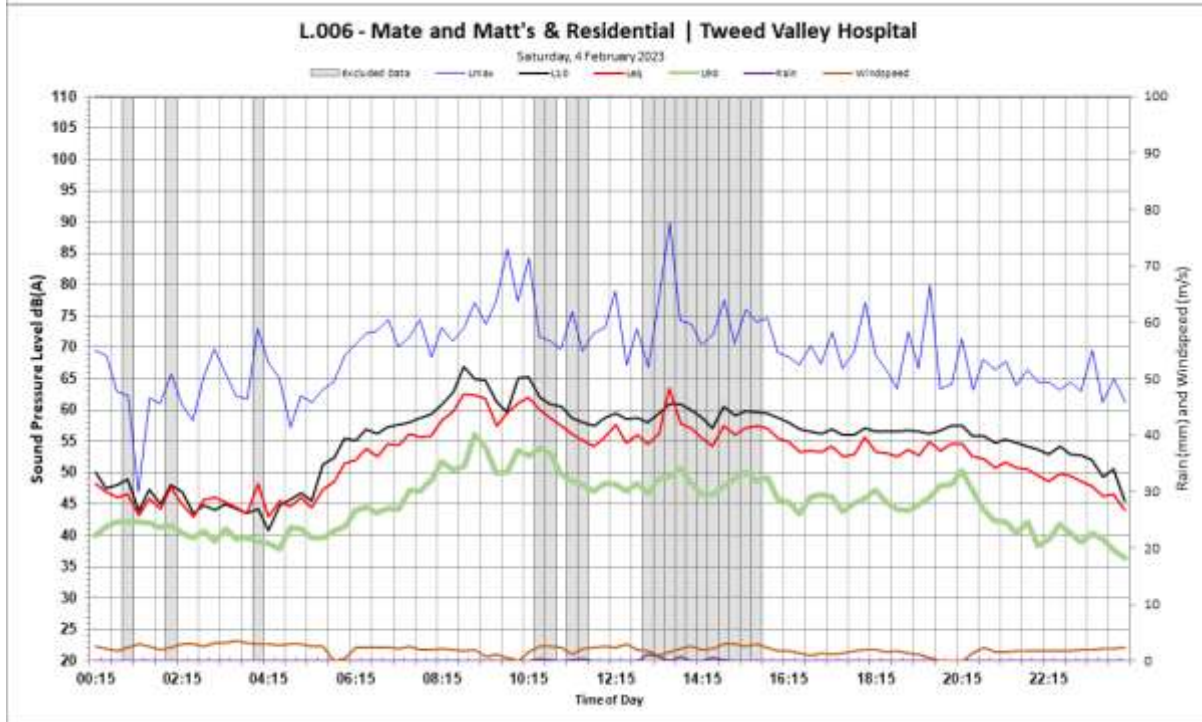
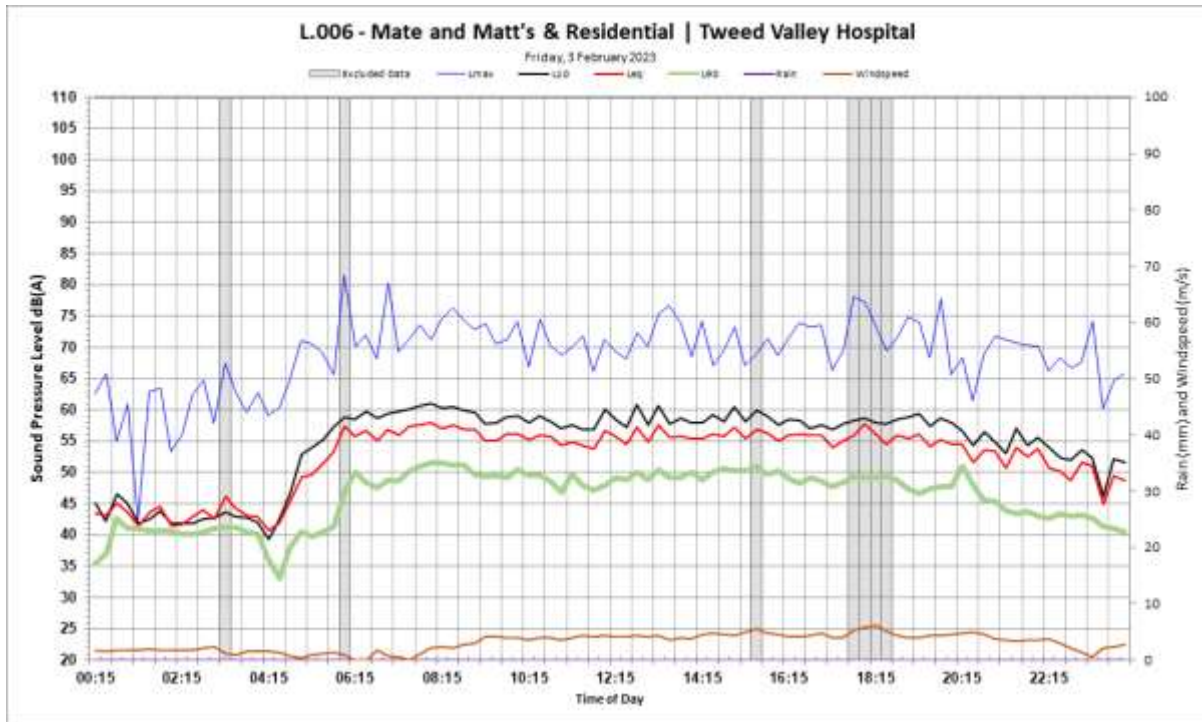


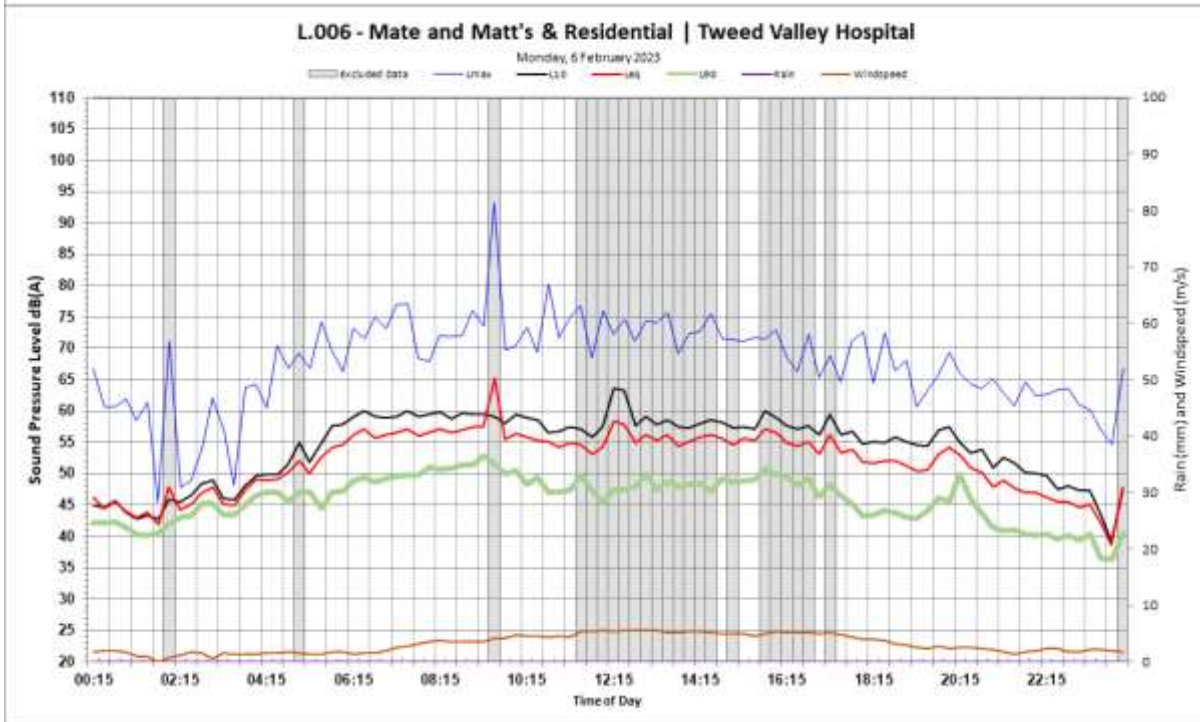
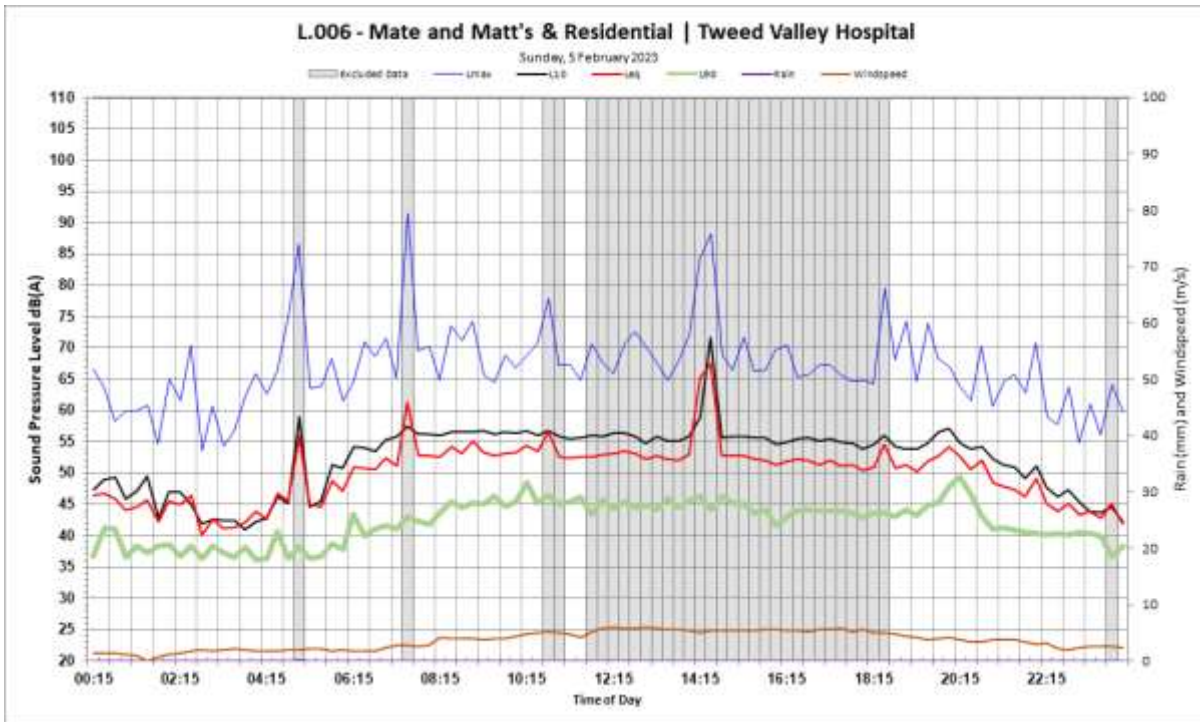


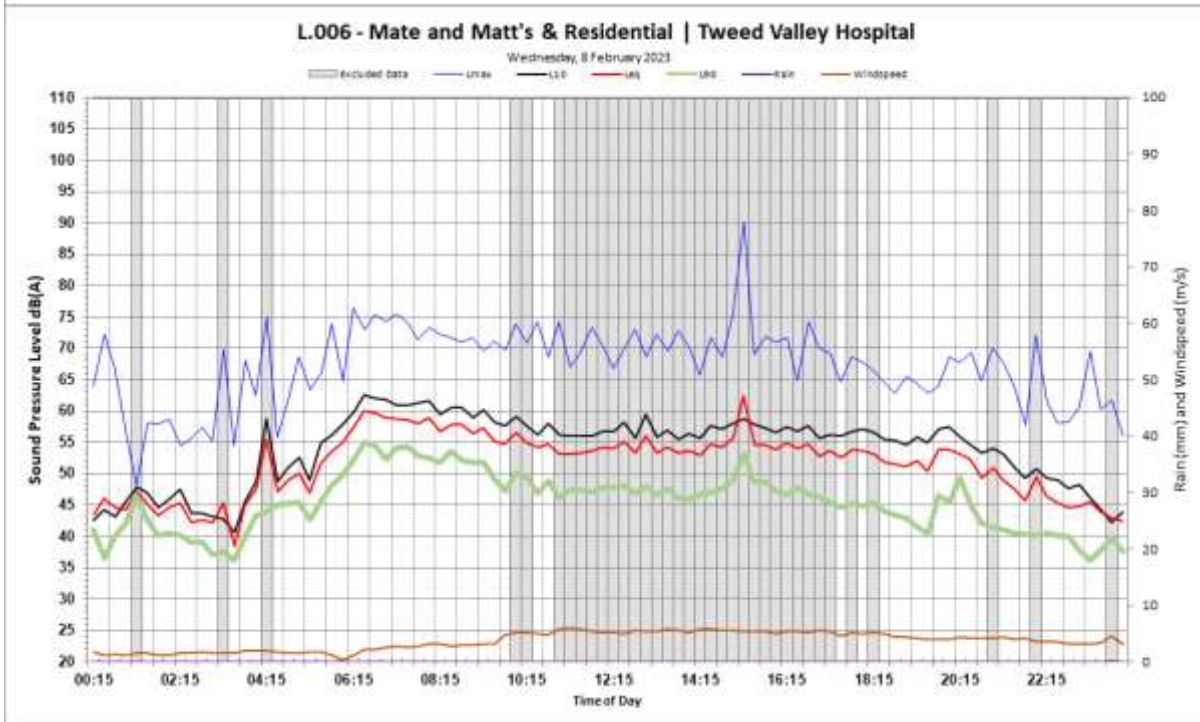
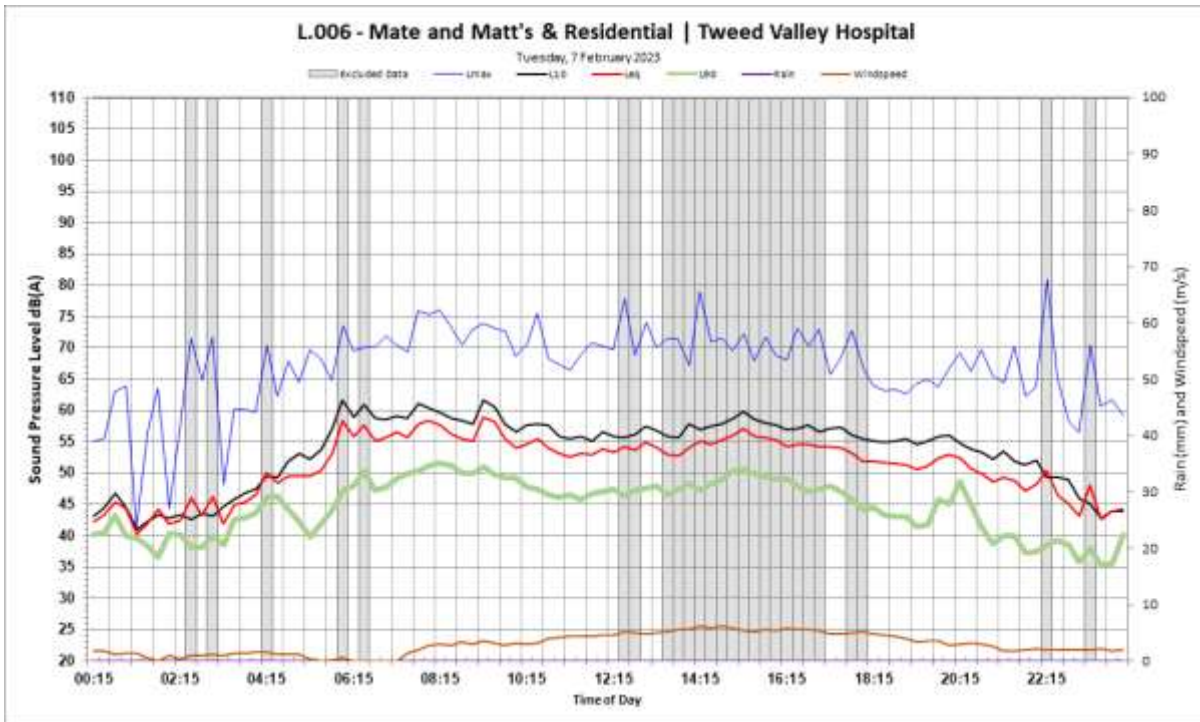


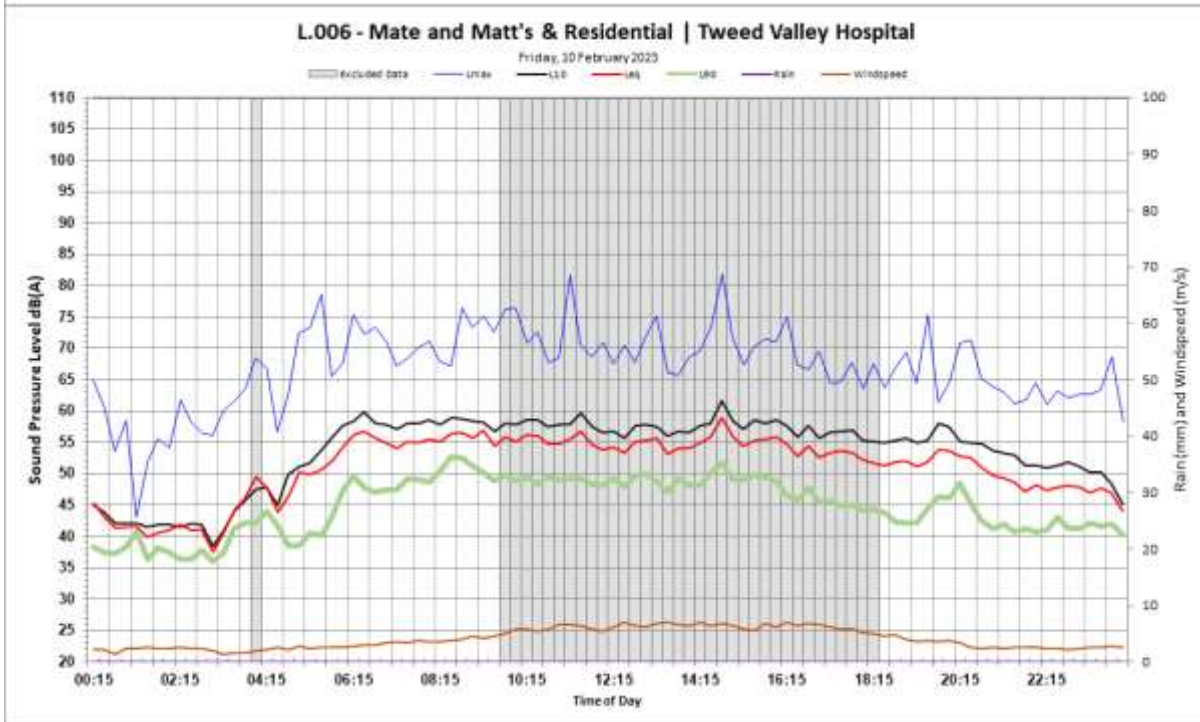
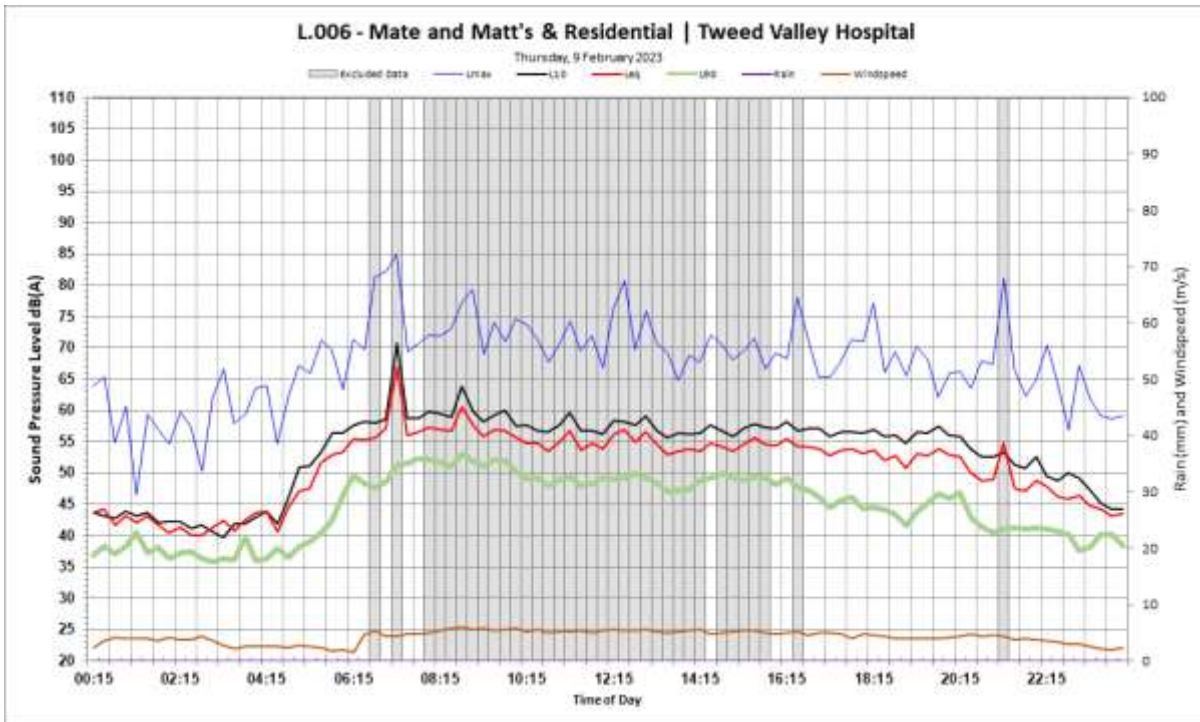


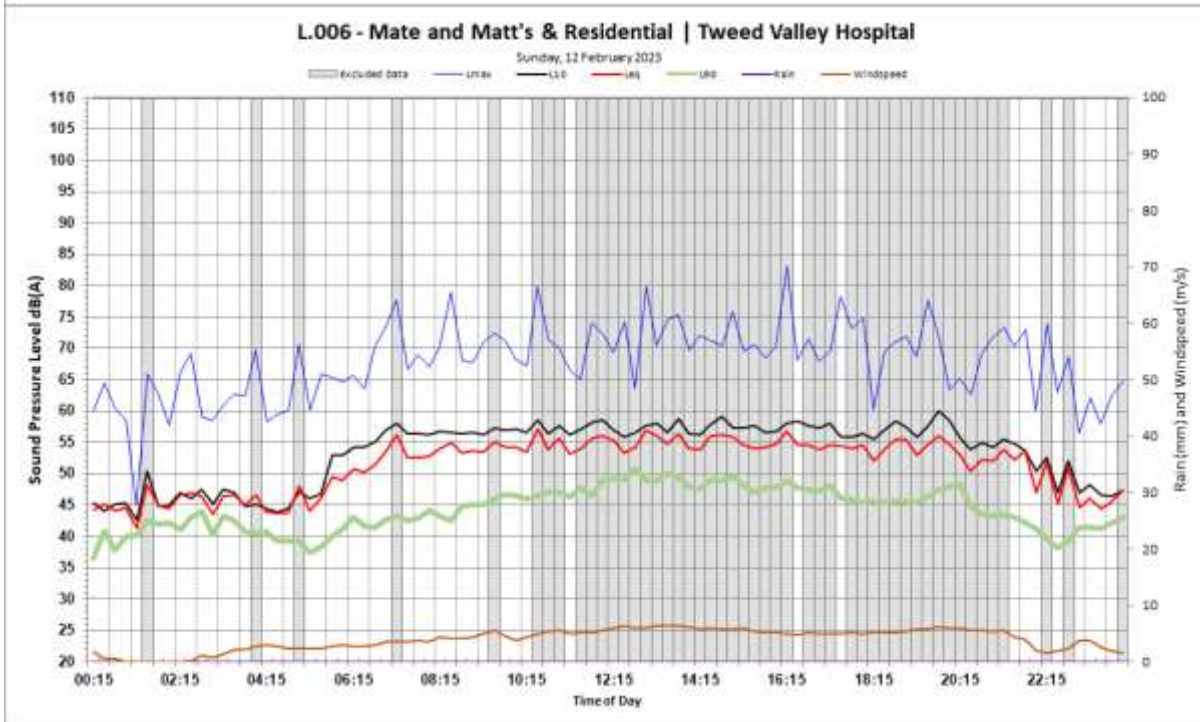
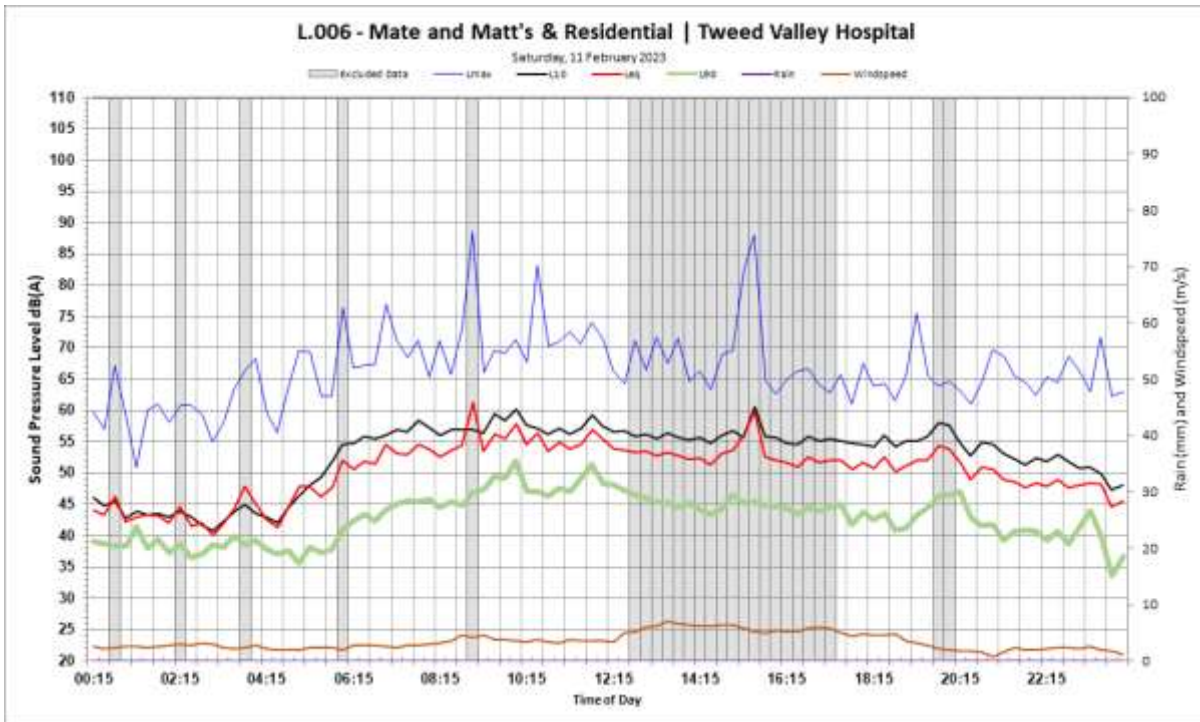


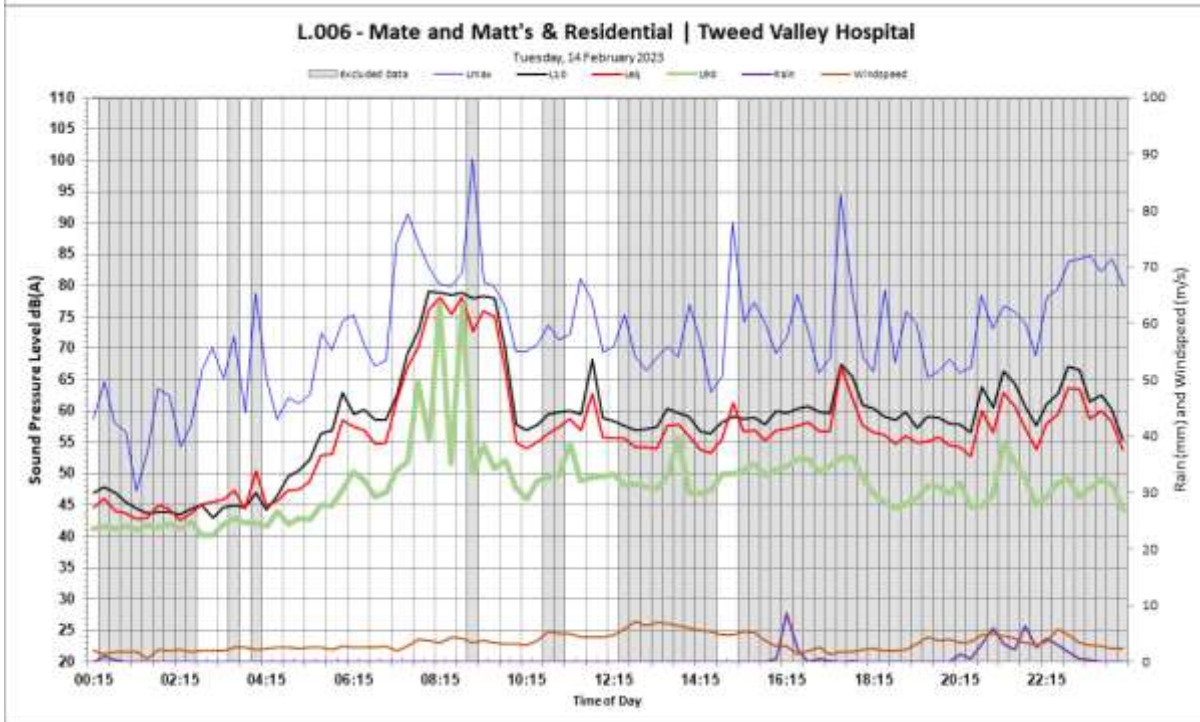
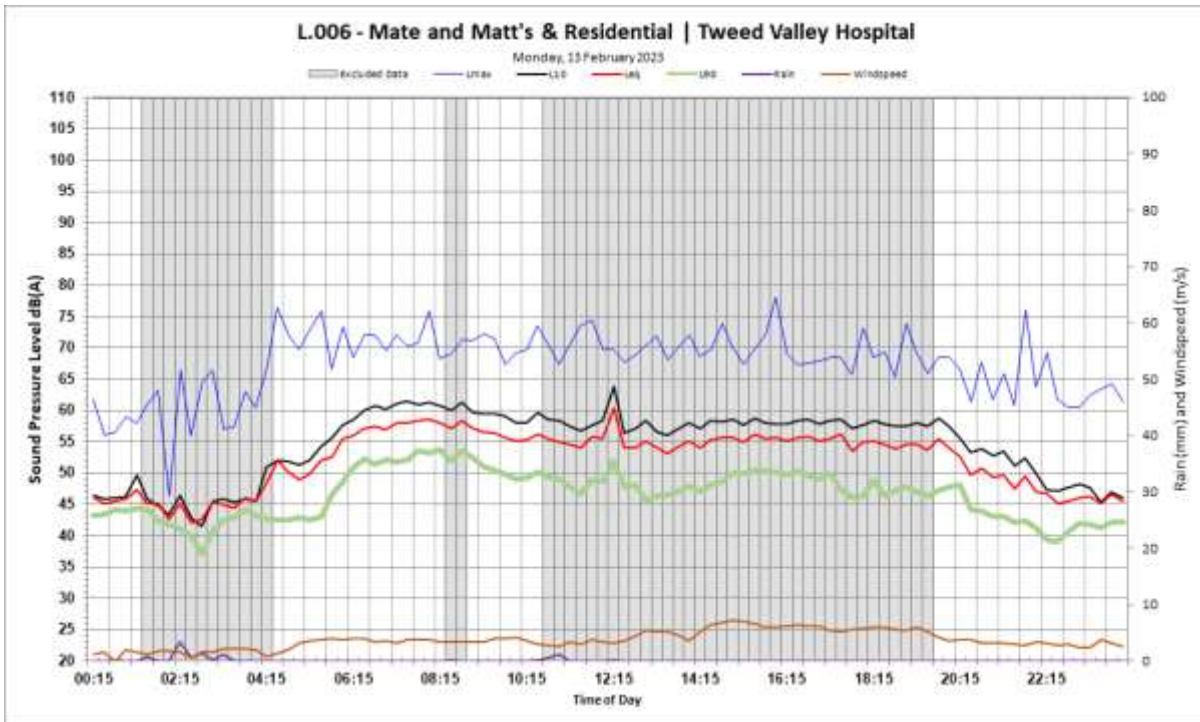


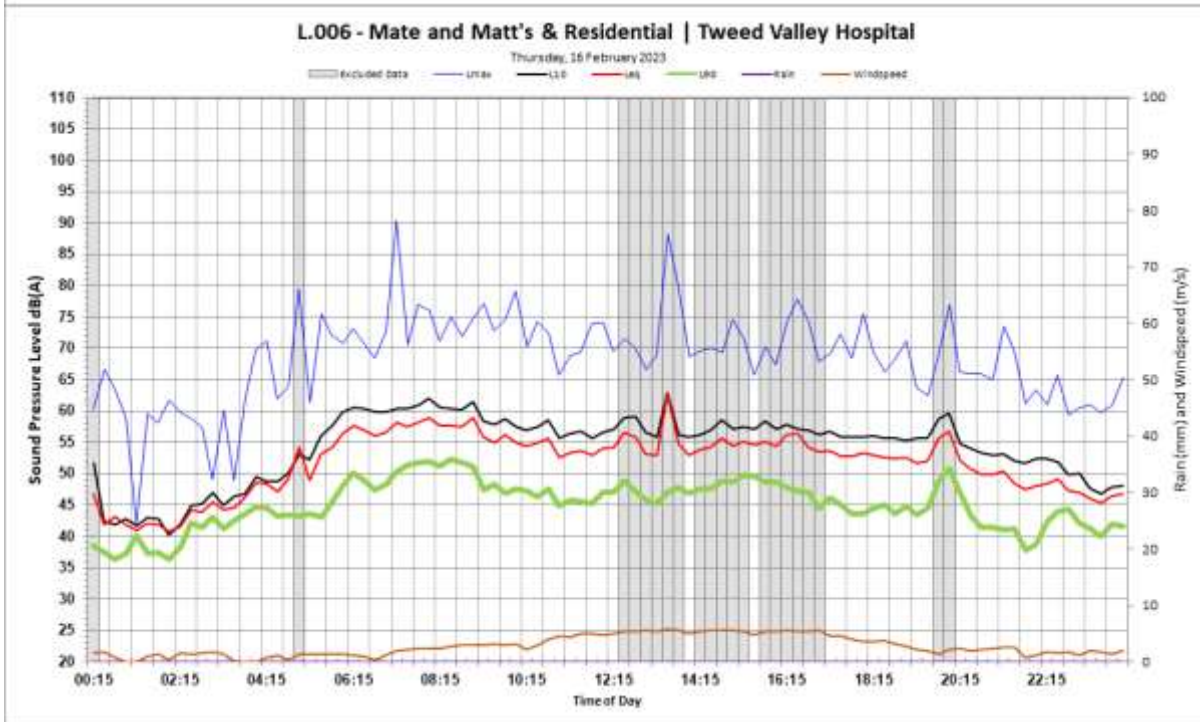
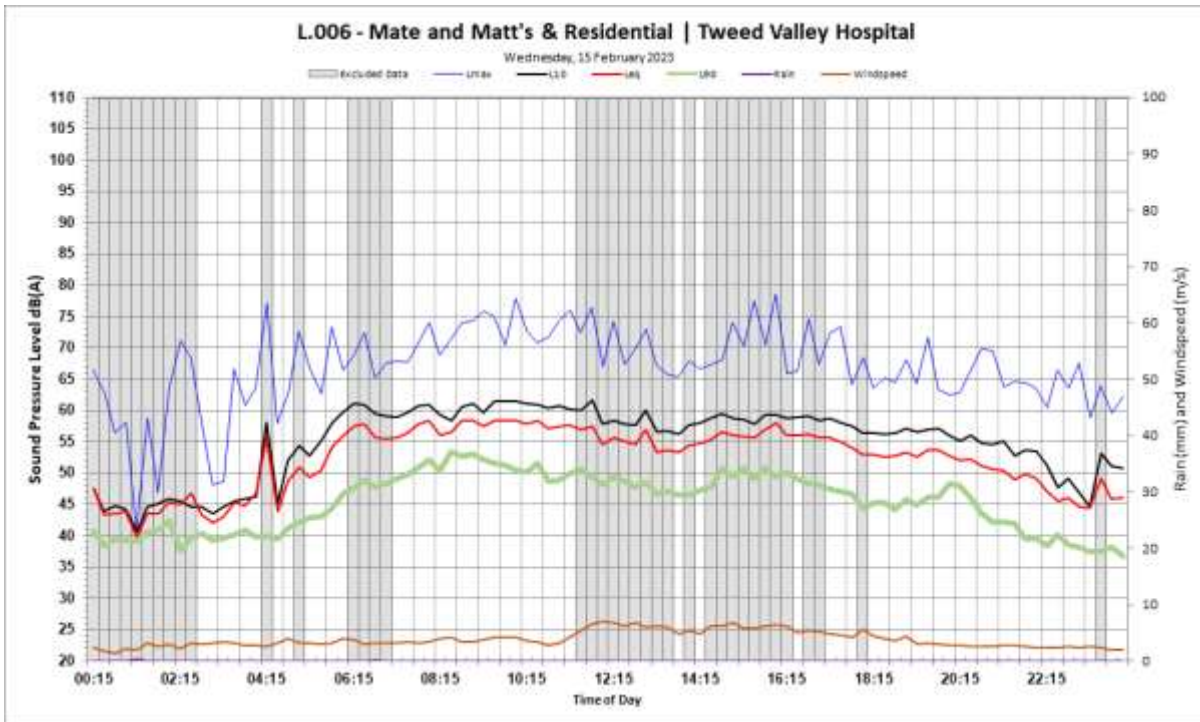


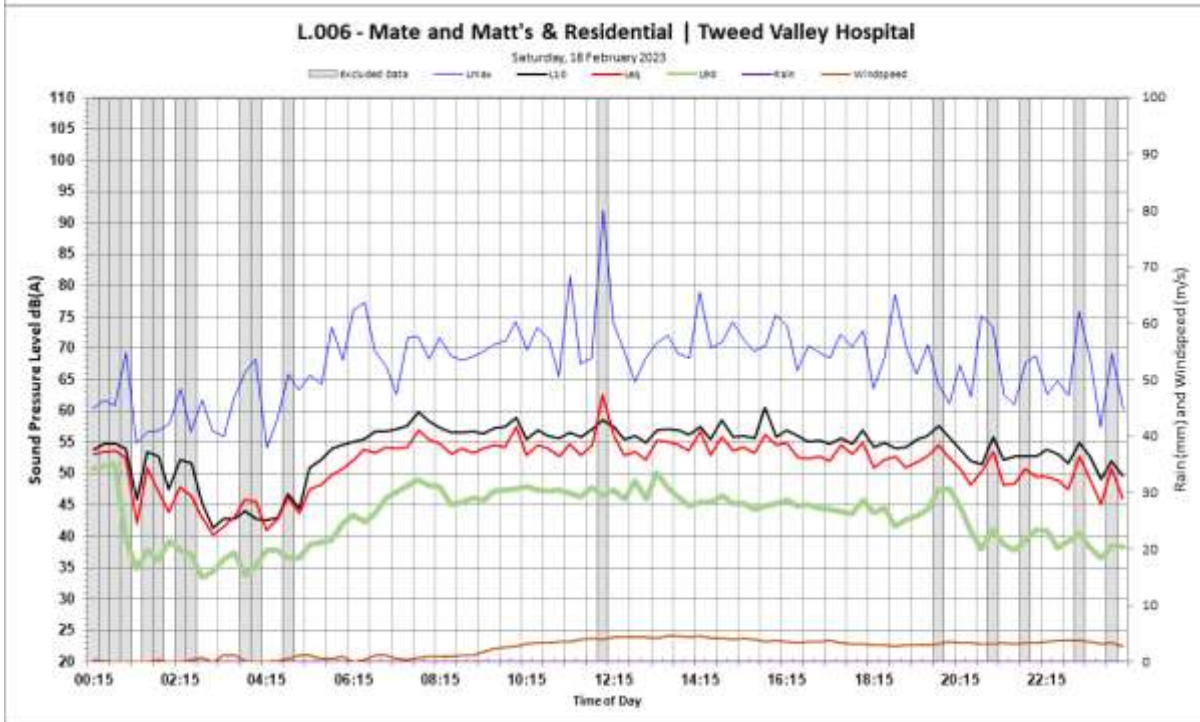
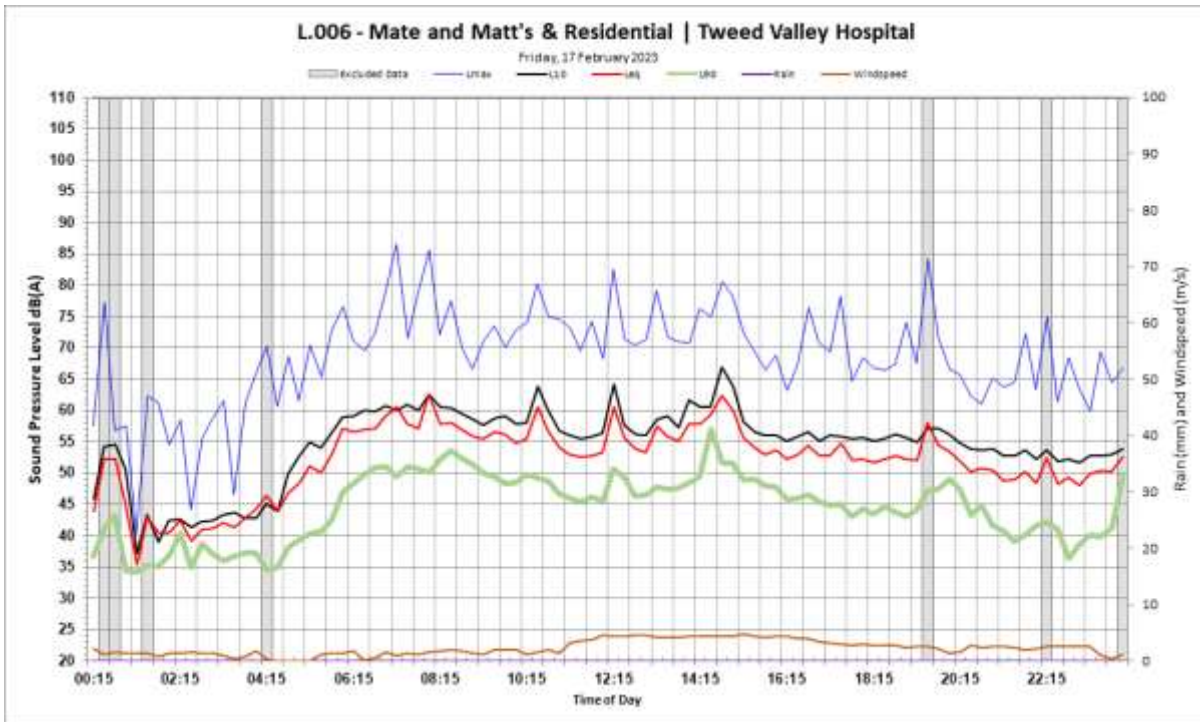


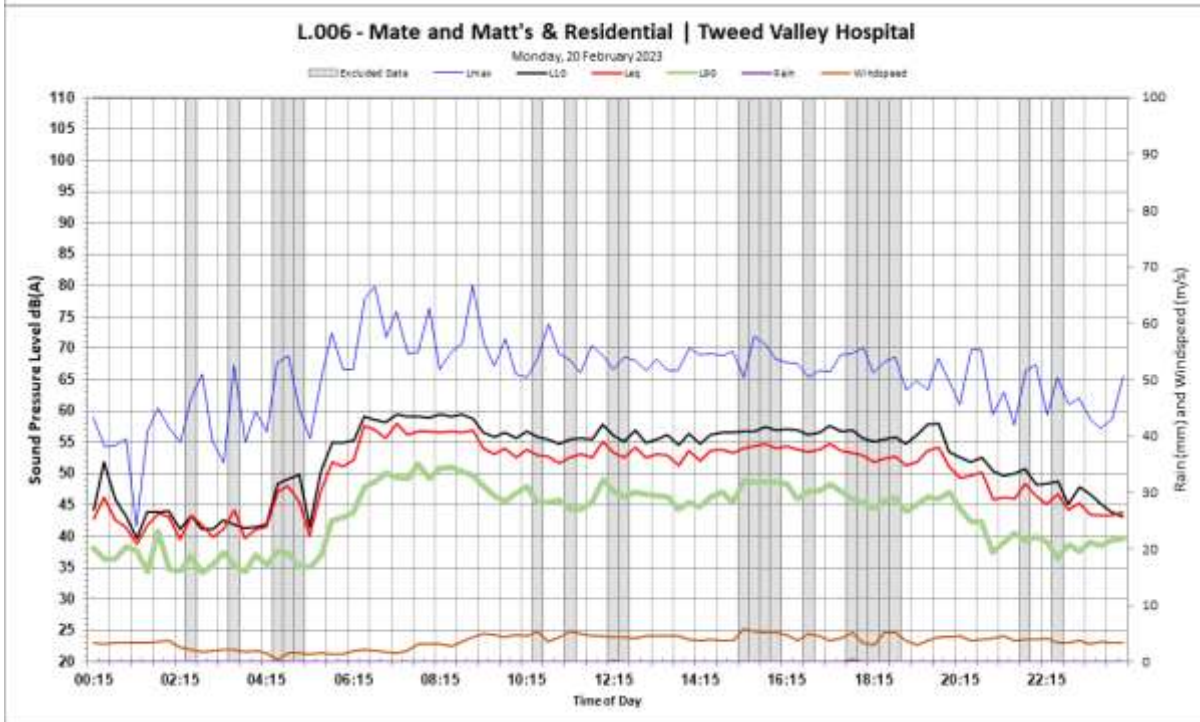
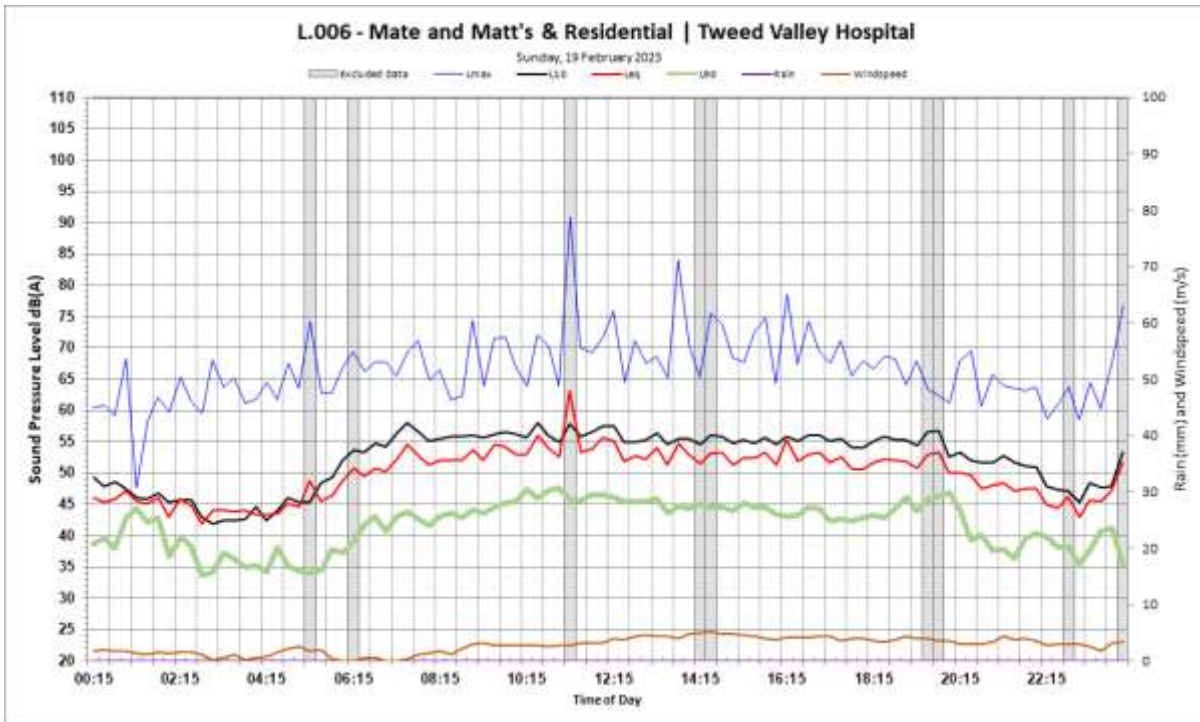


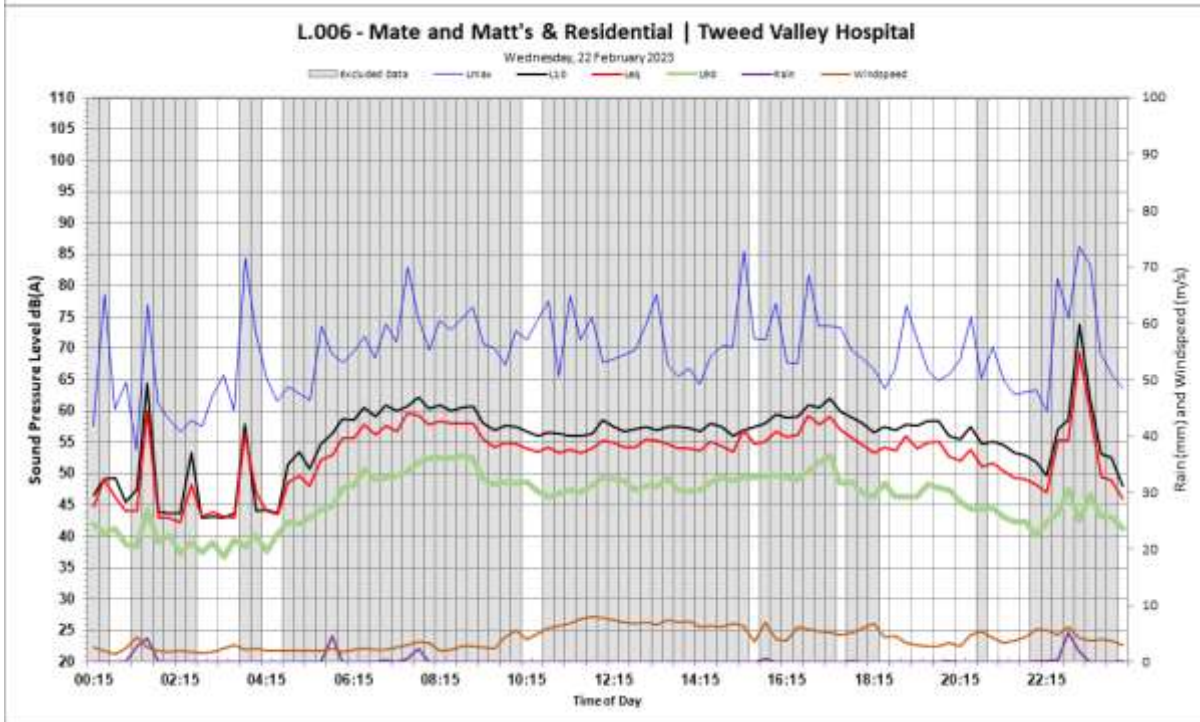
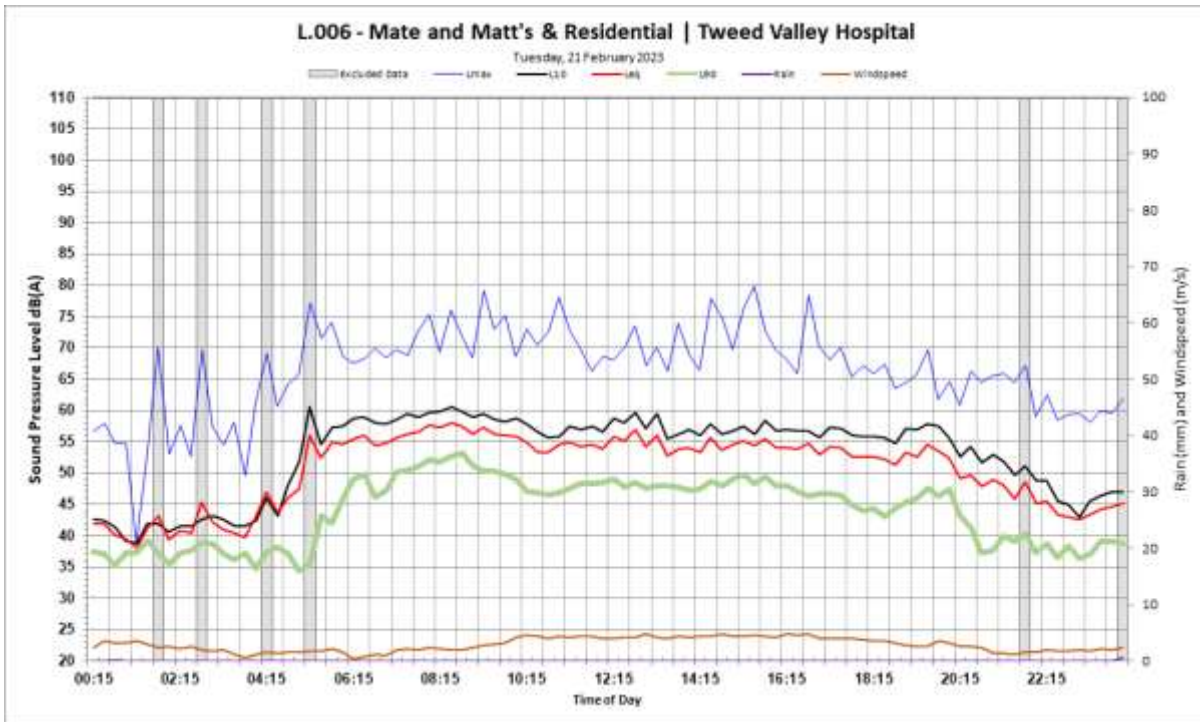


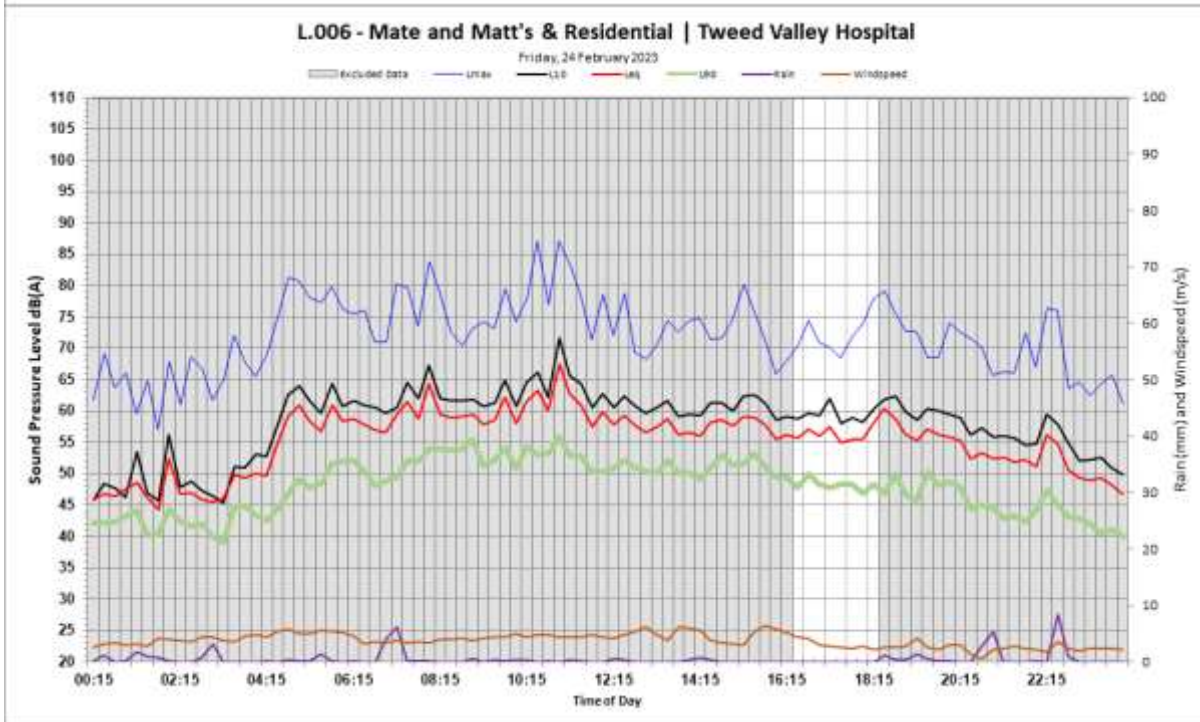
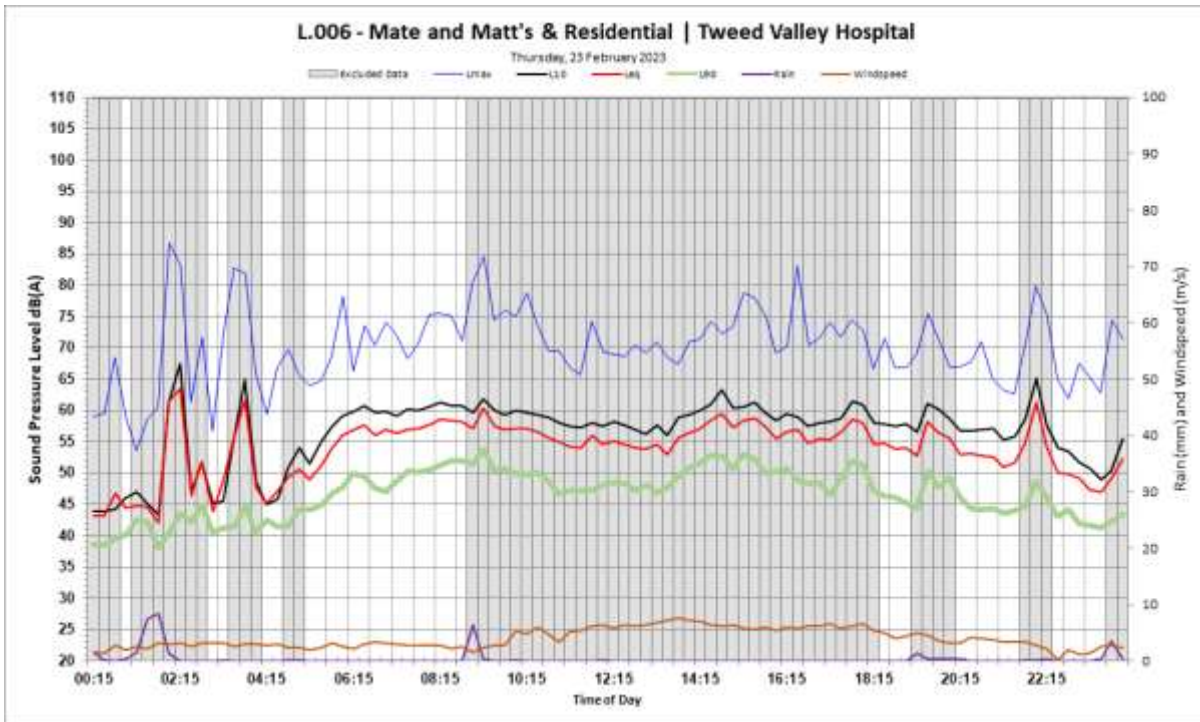






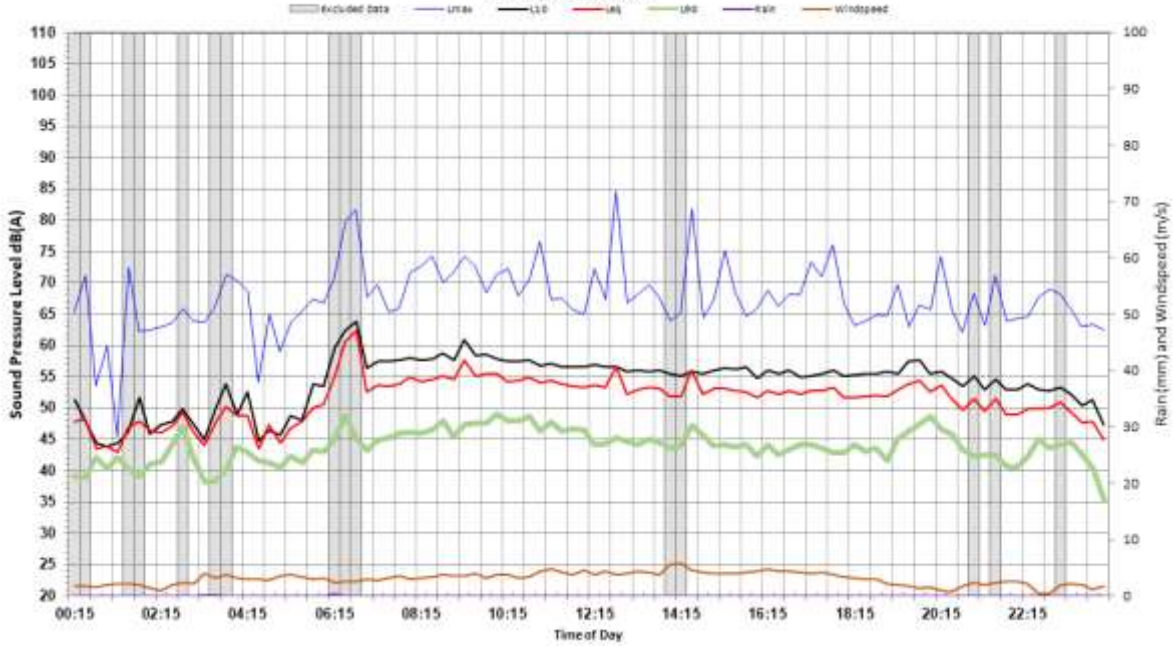






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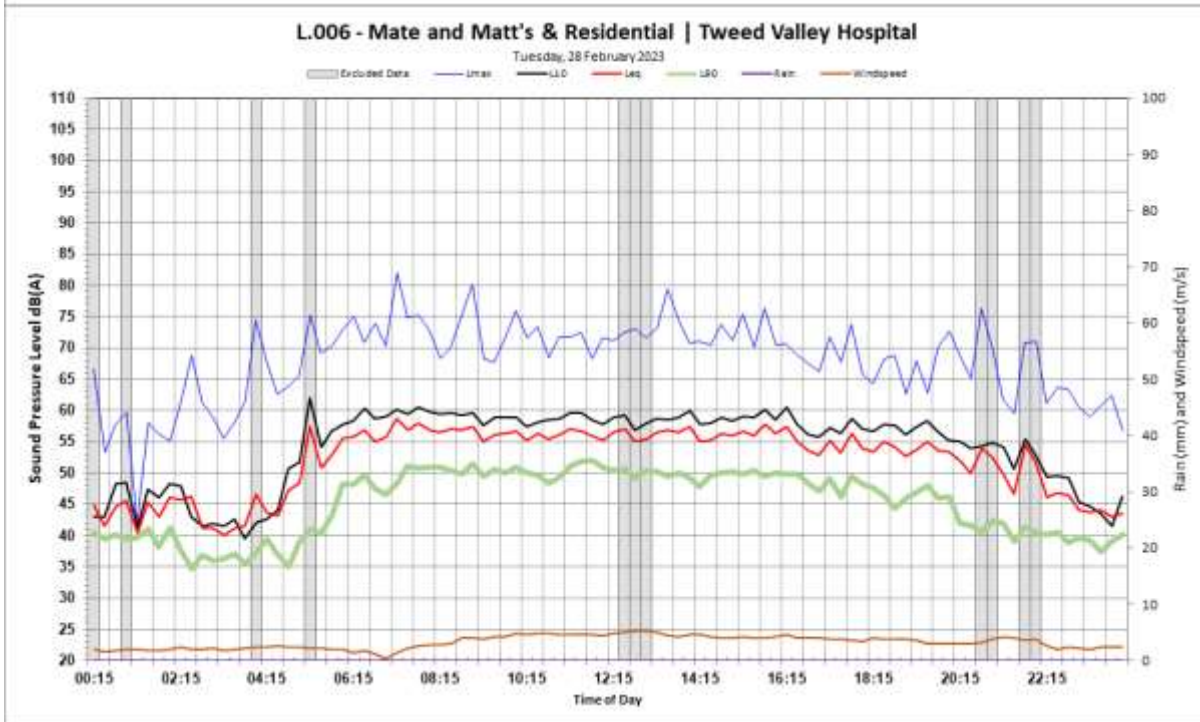
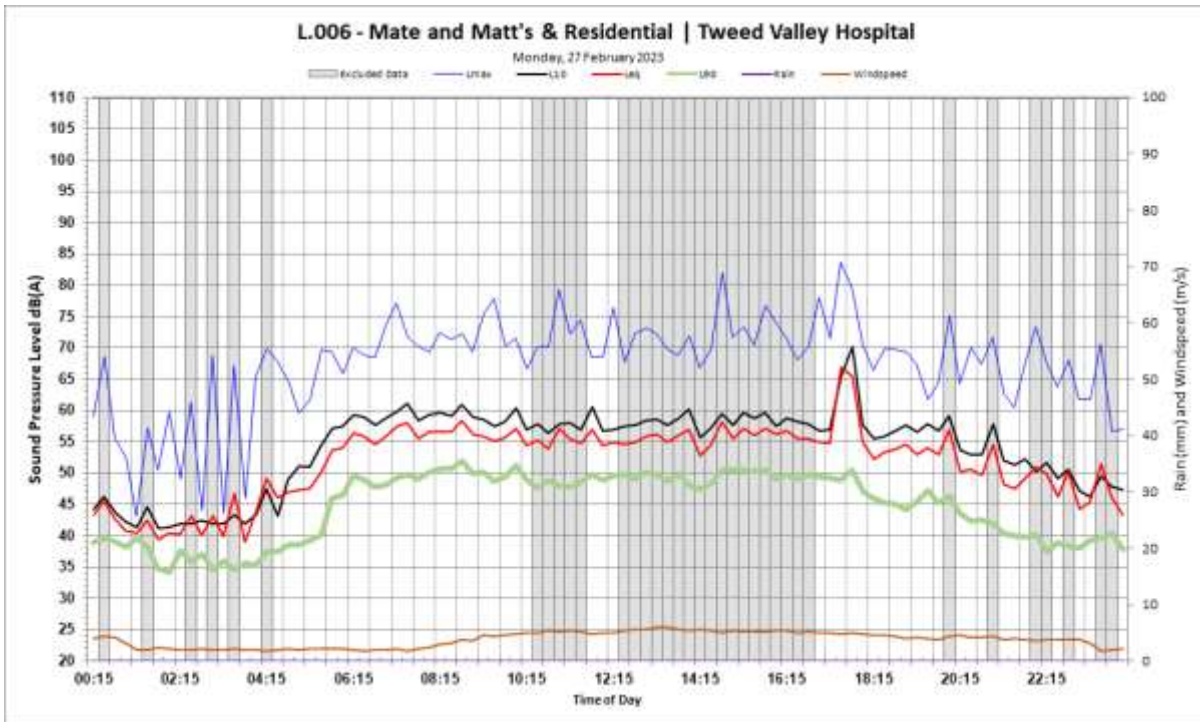
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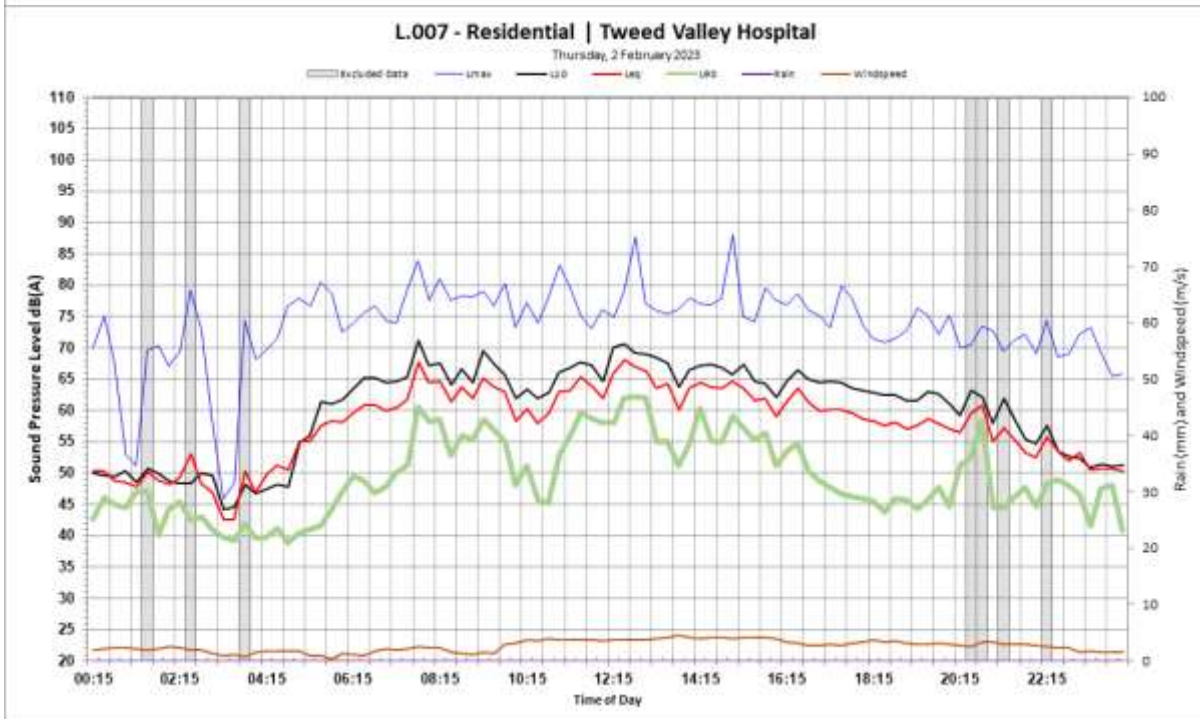
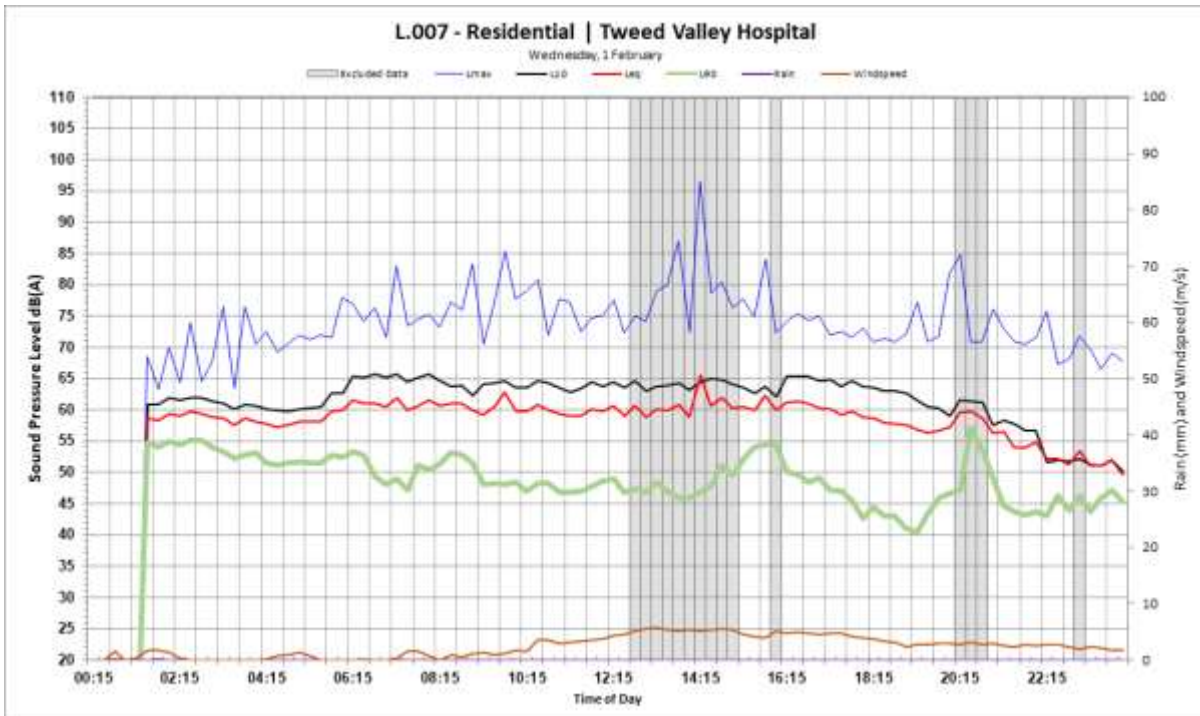


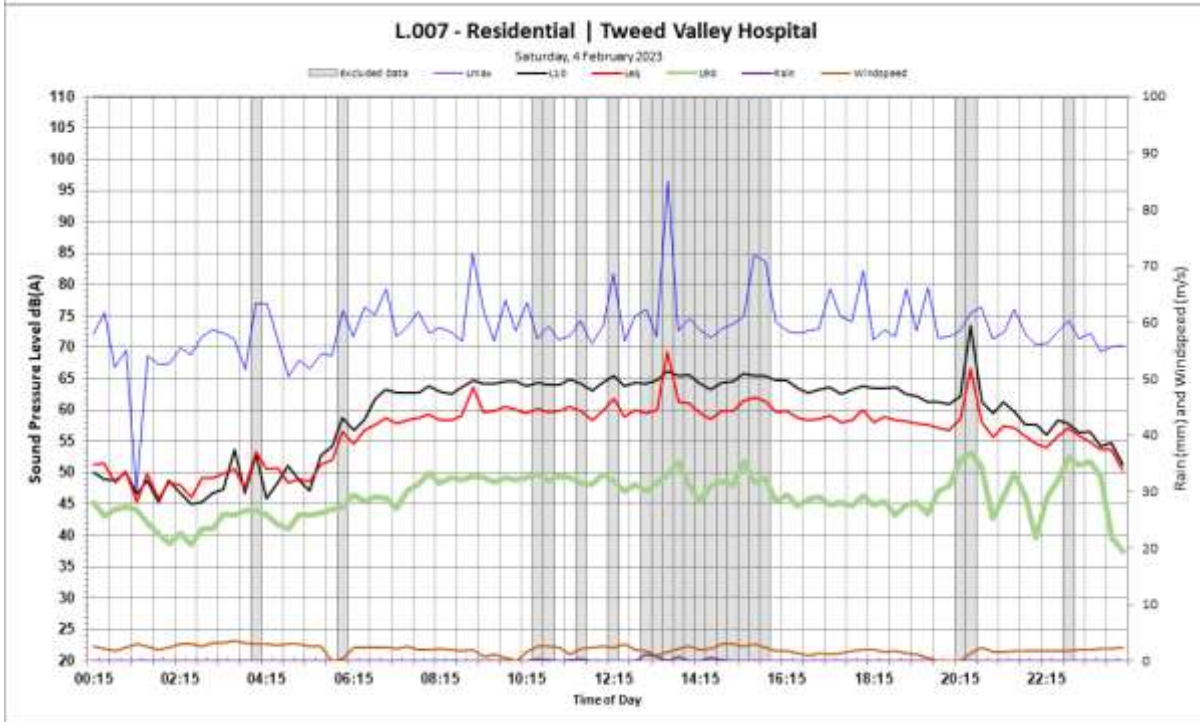
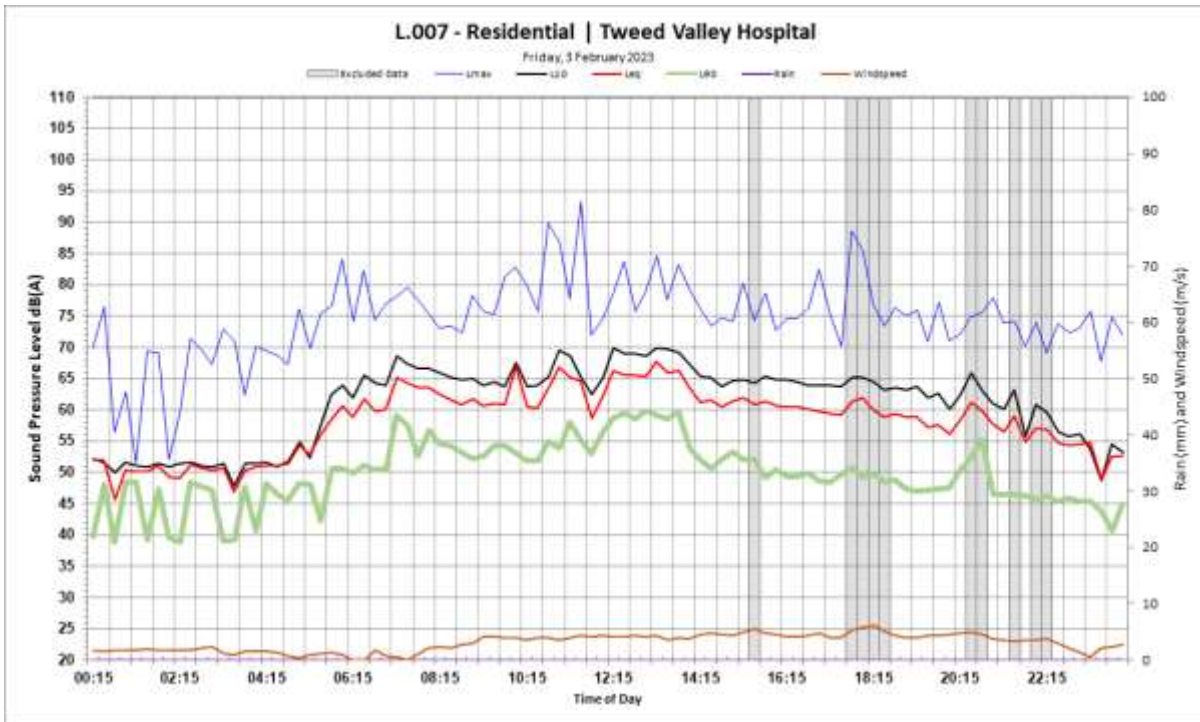
L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

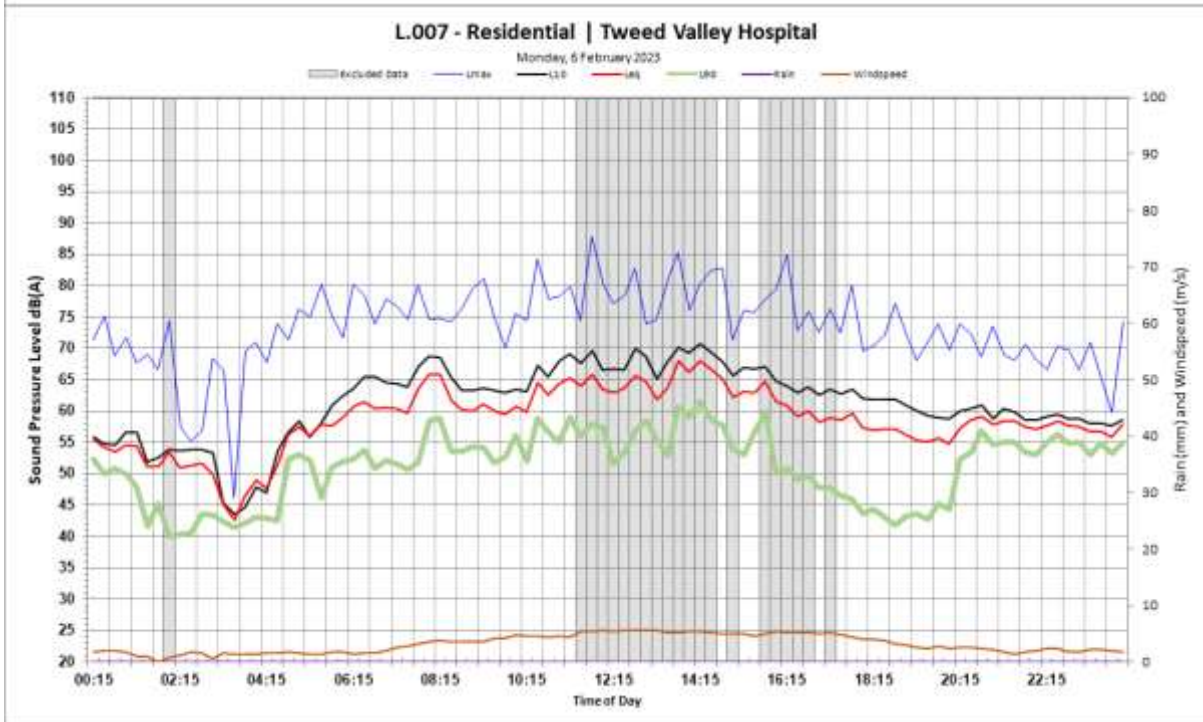
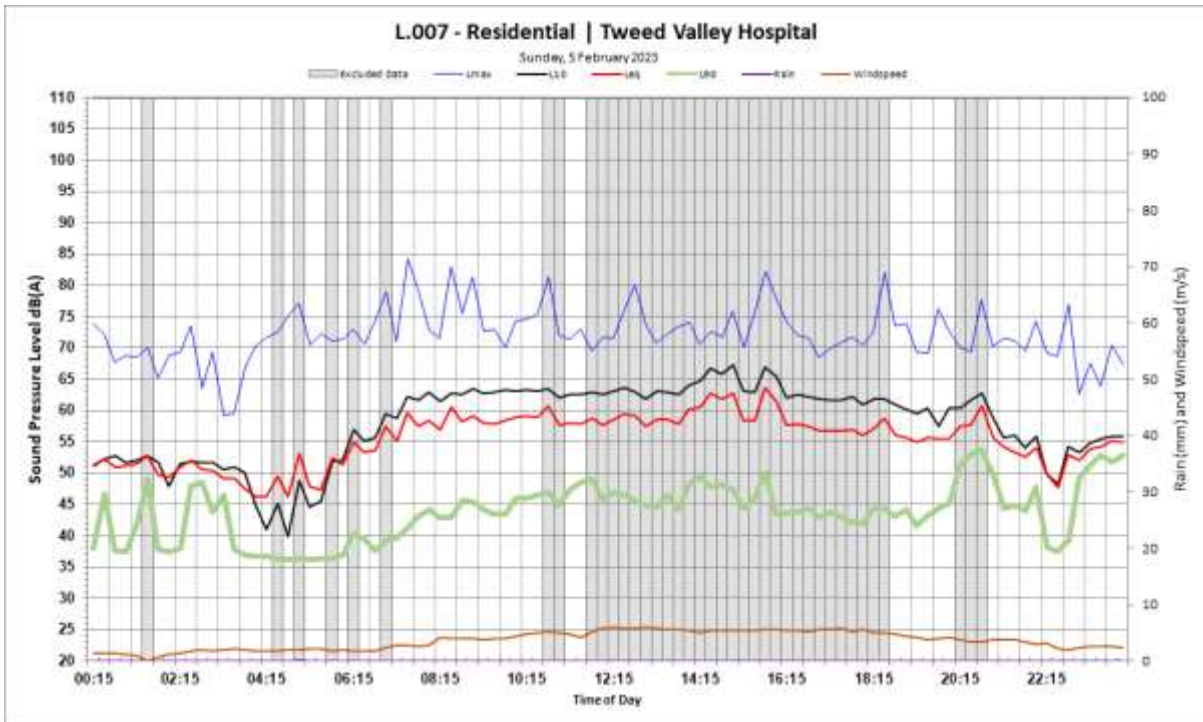
Sunday, 26 February 2023

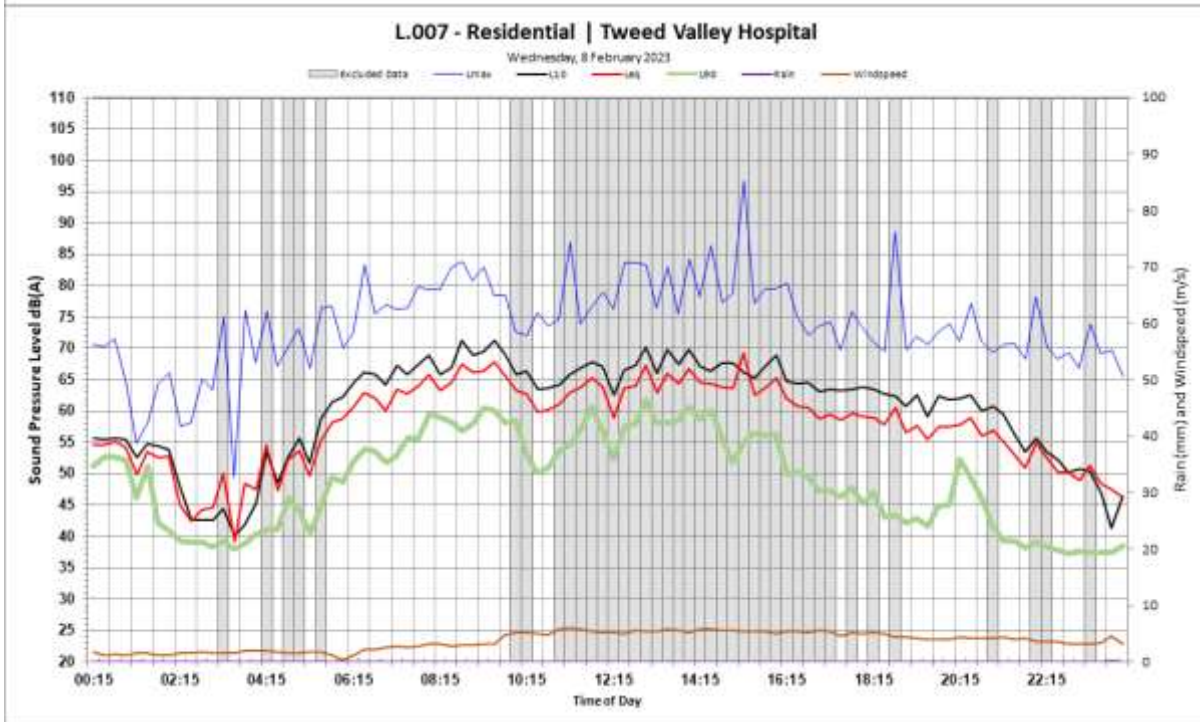
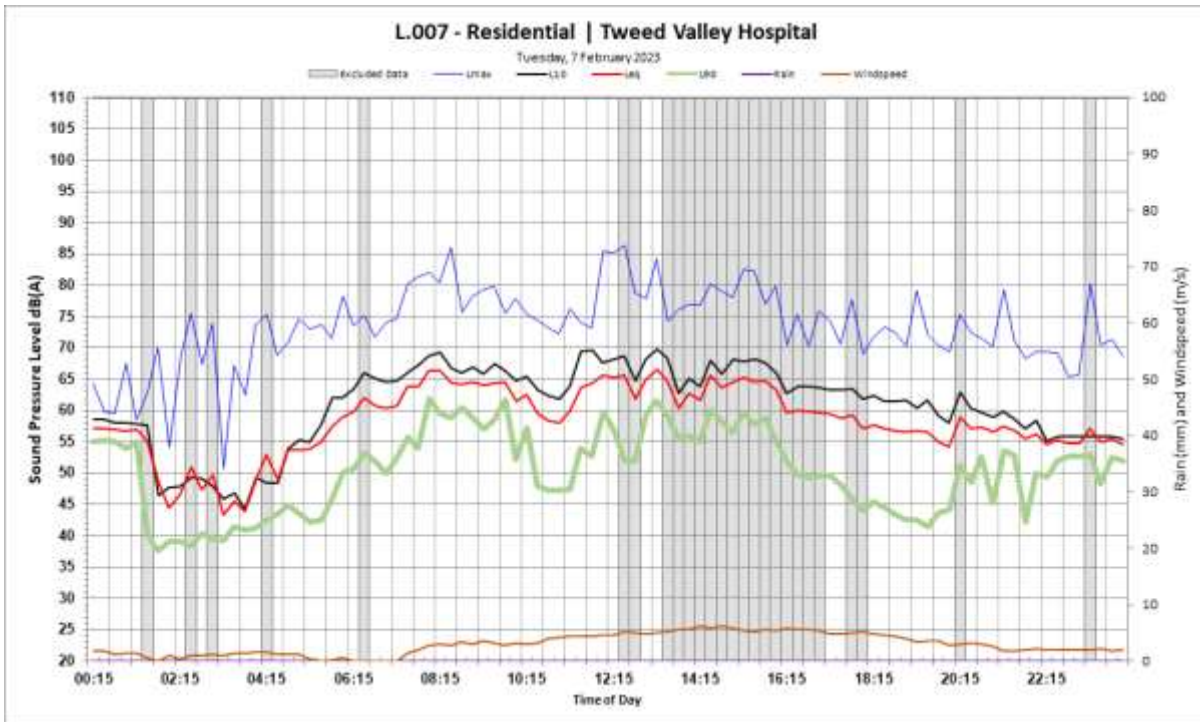


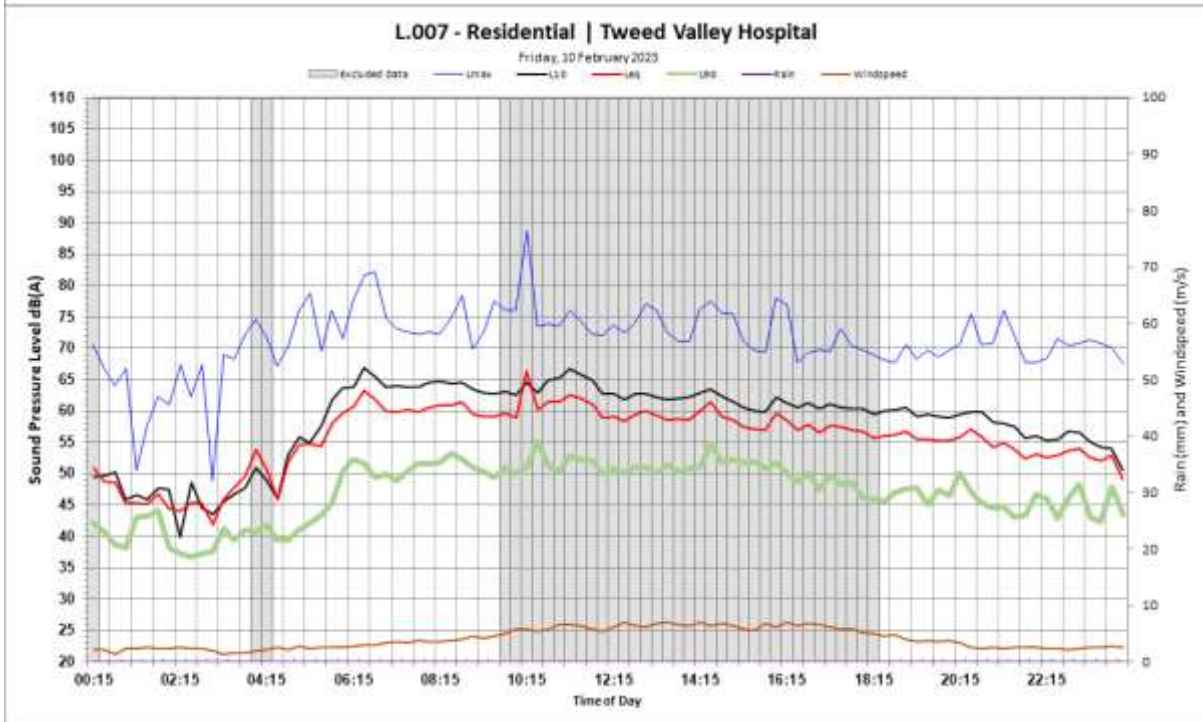
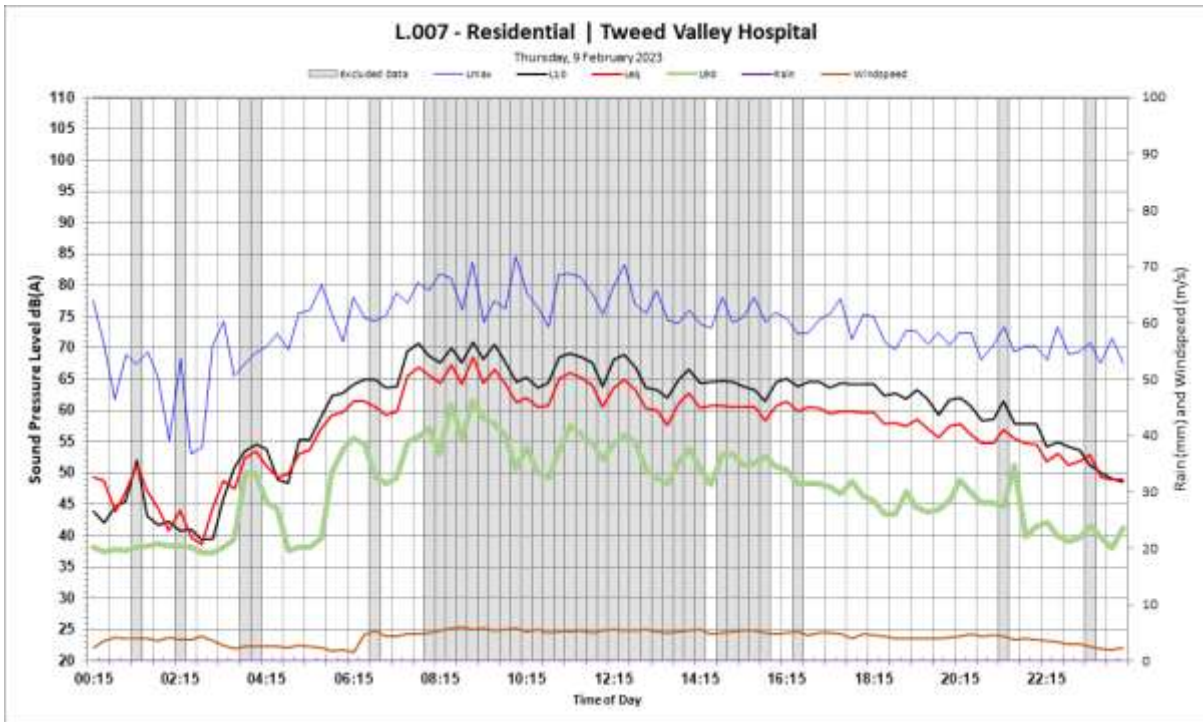


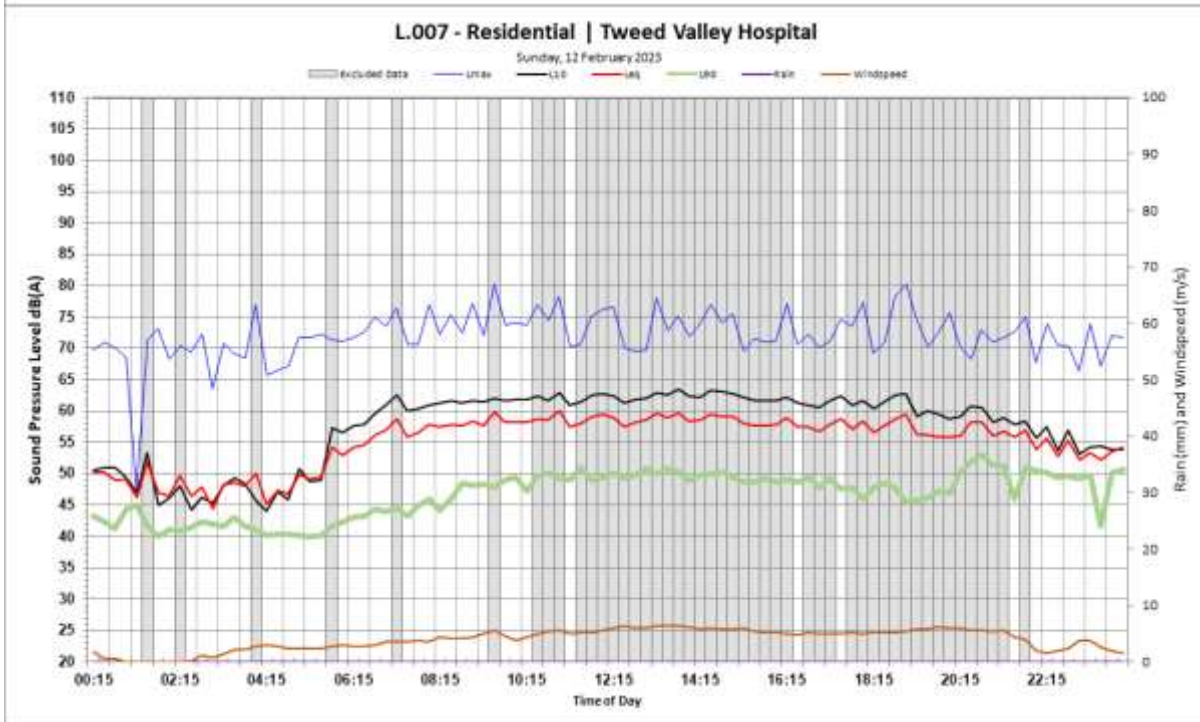
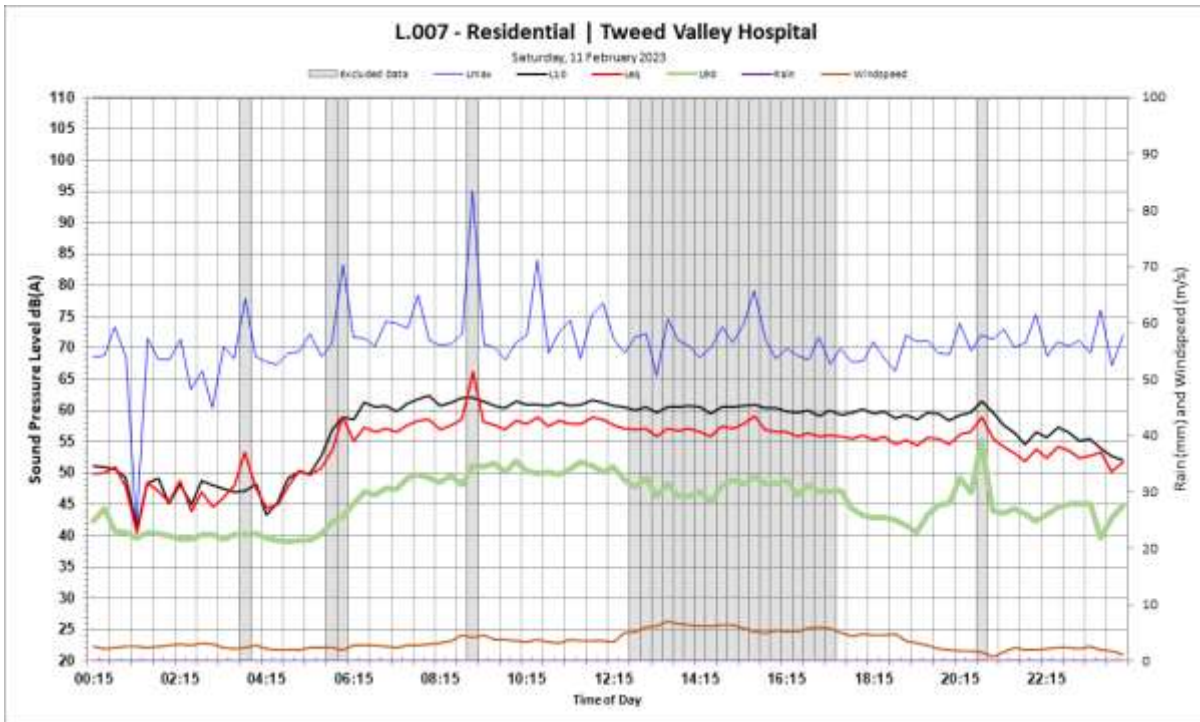


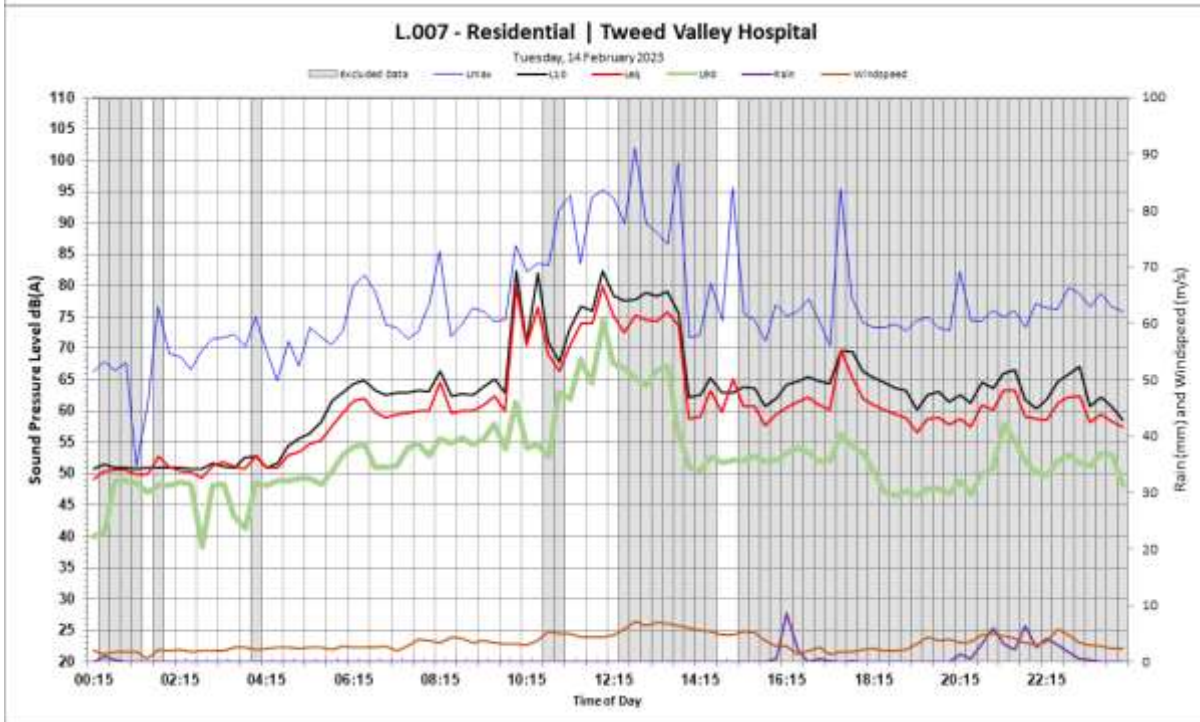
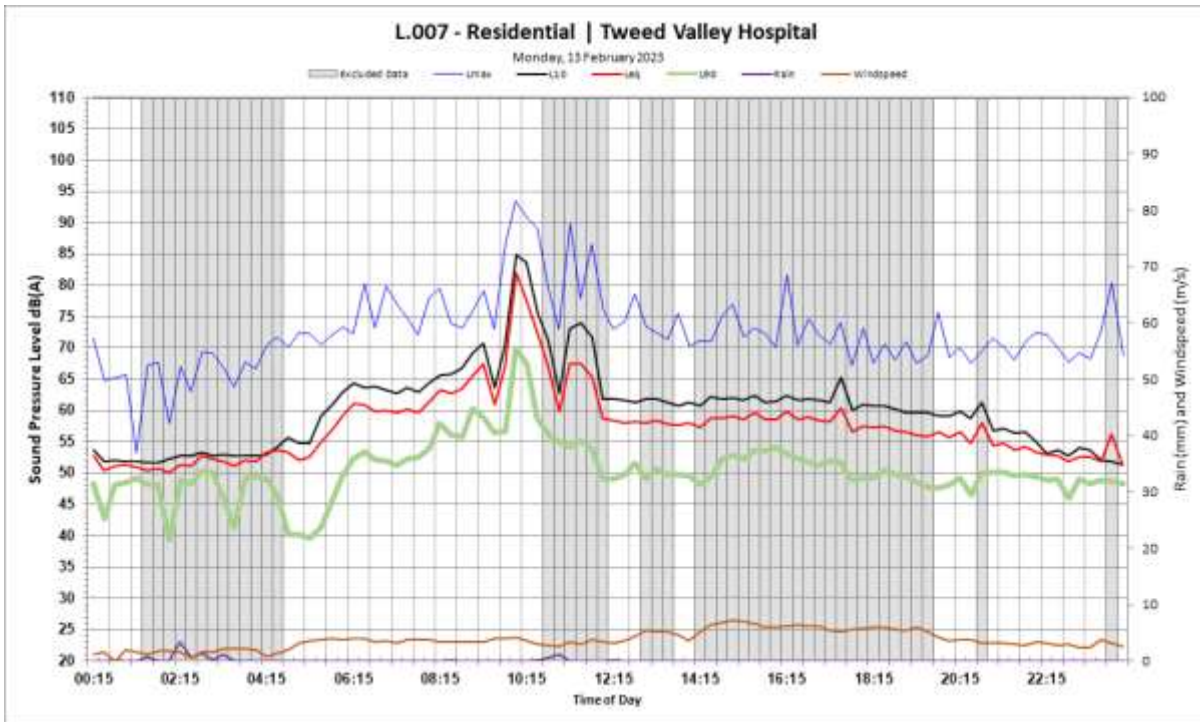


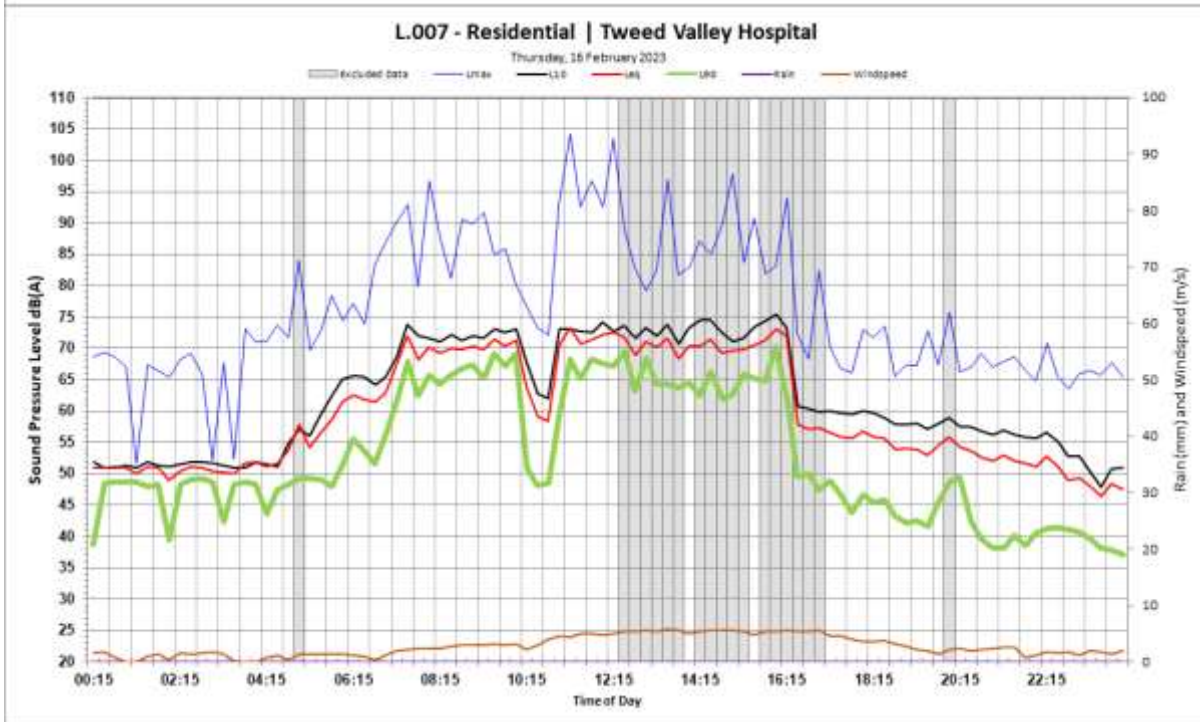
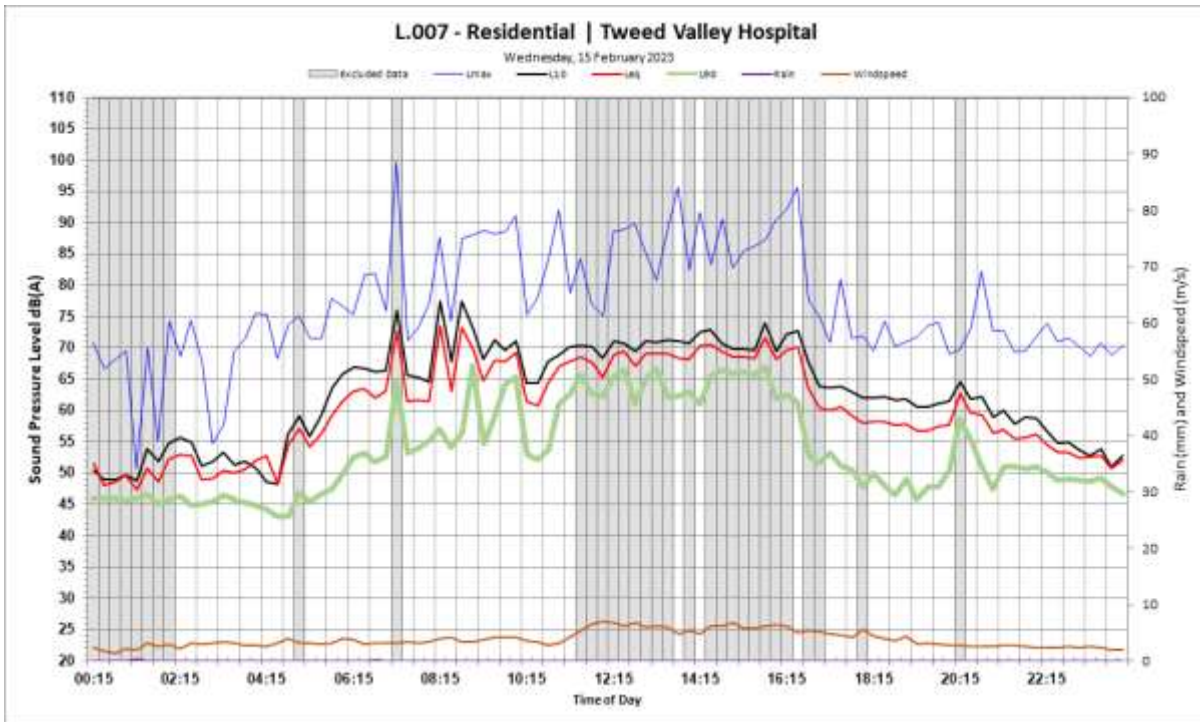


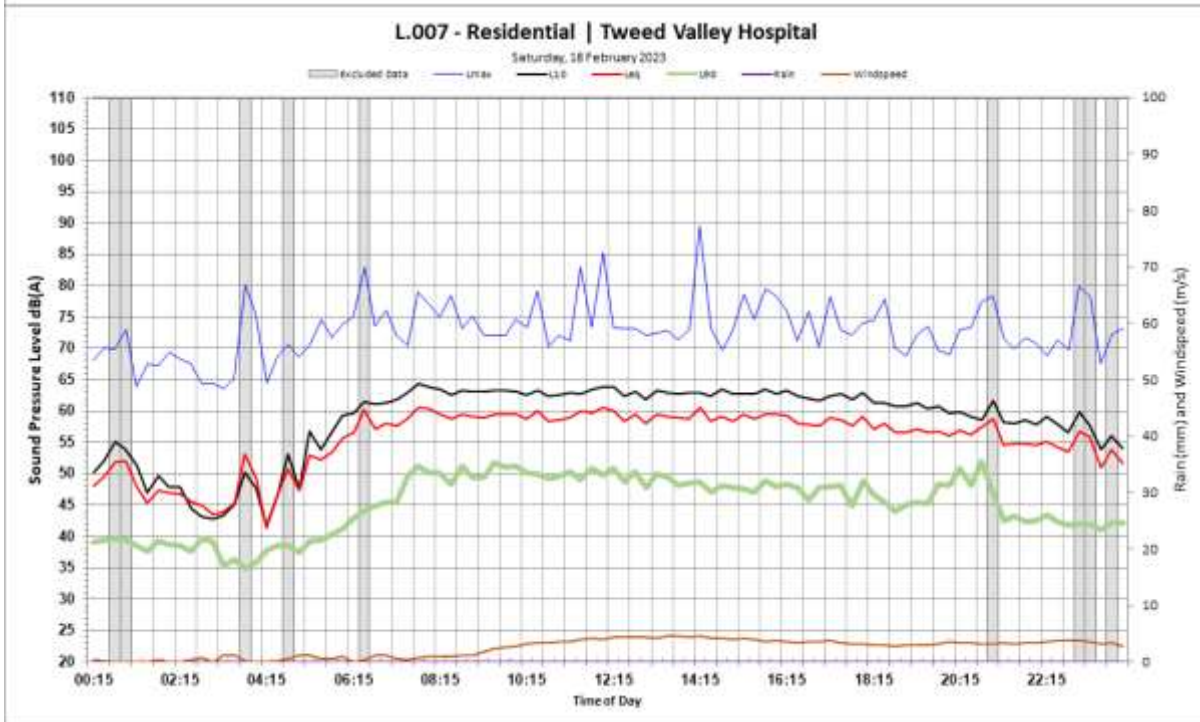
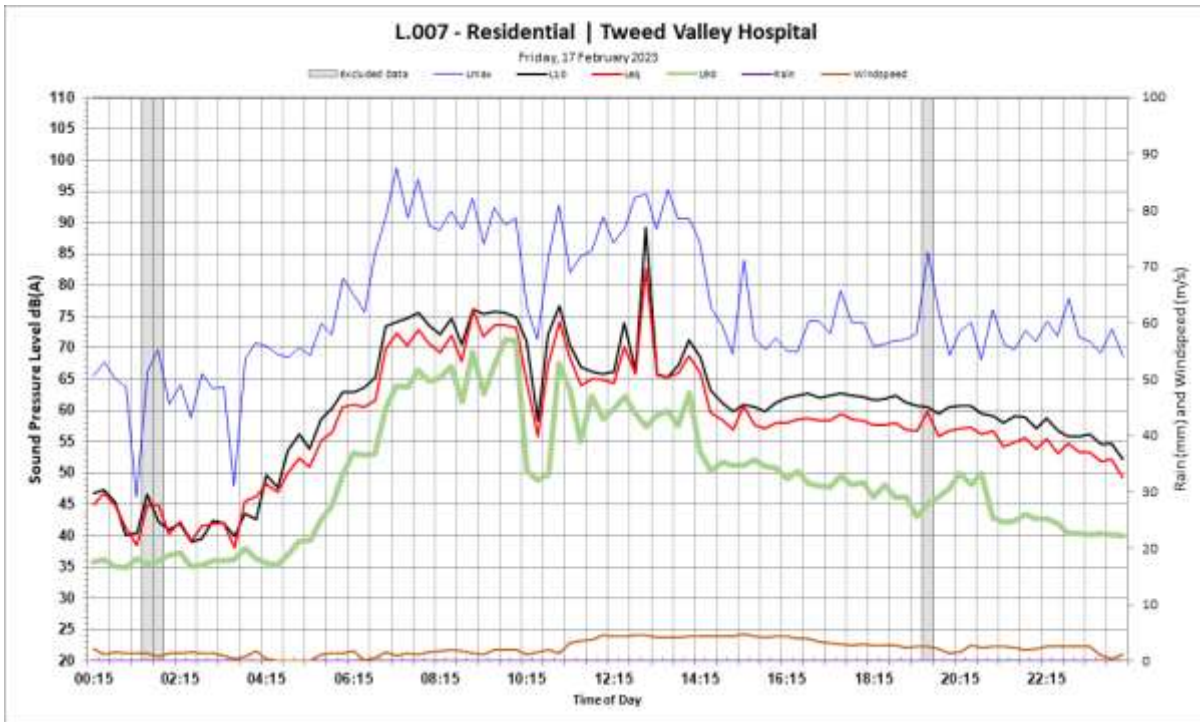


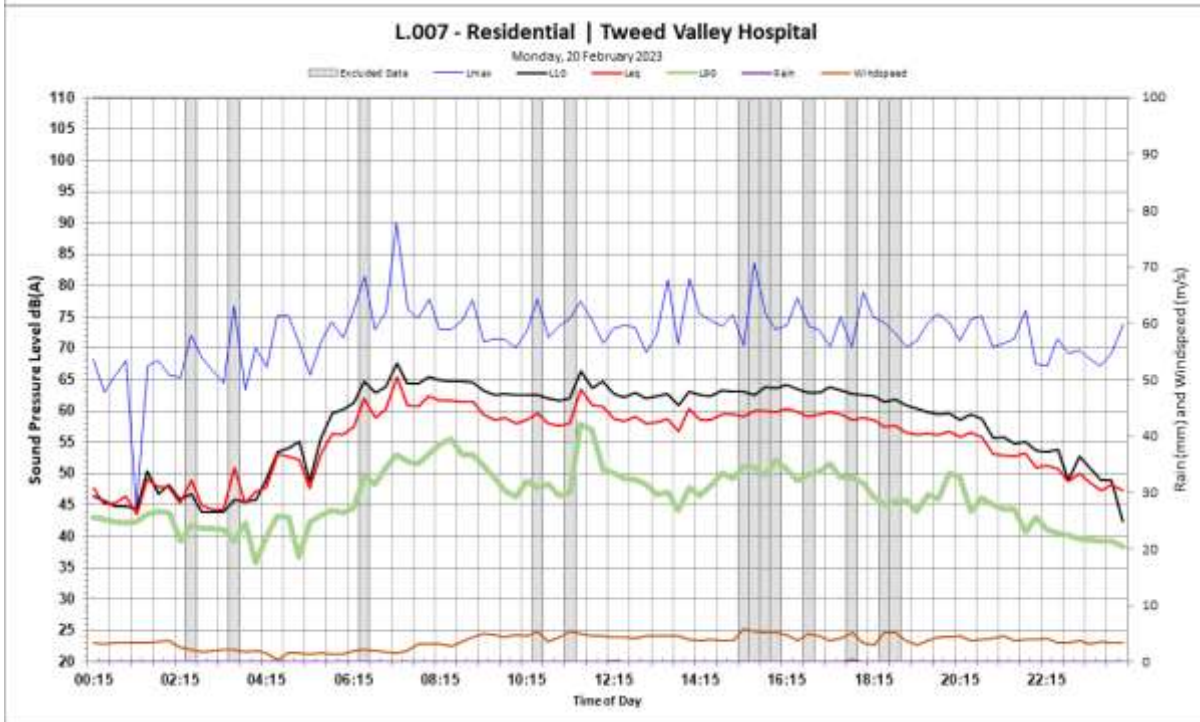
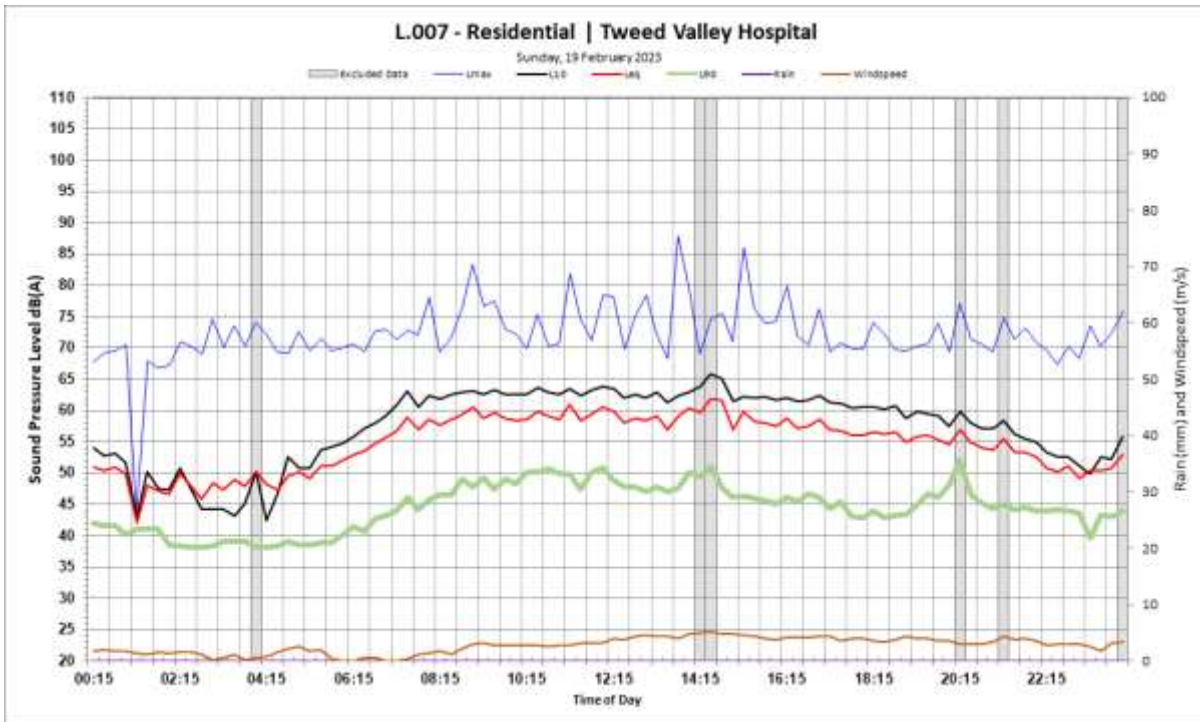


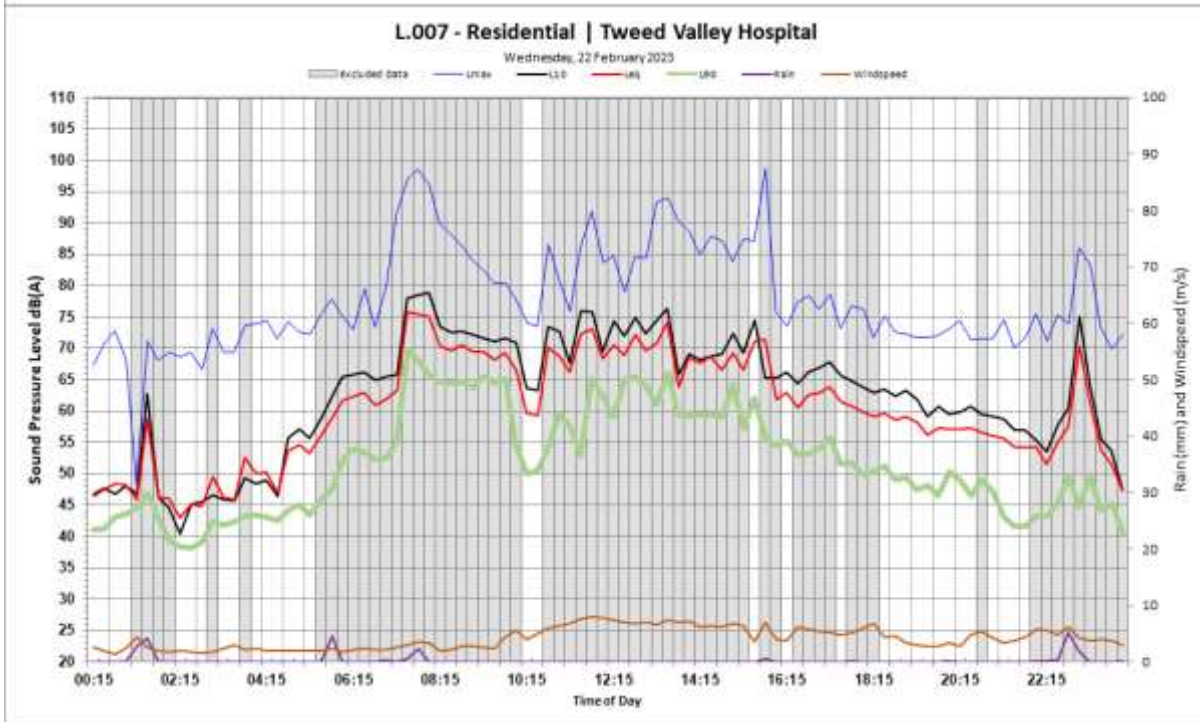
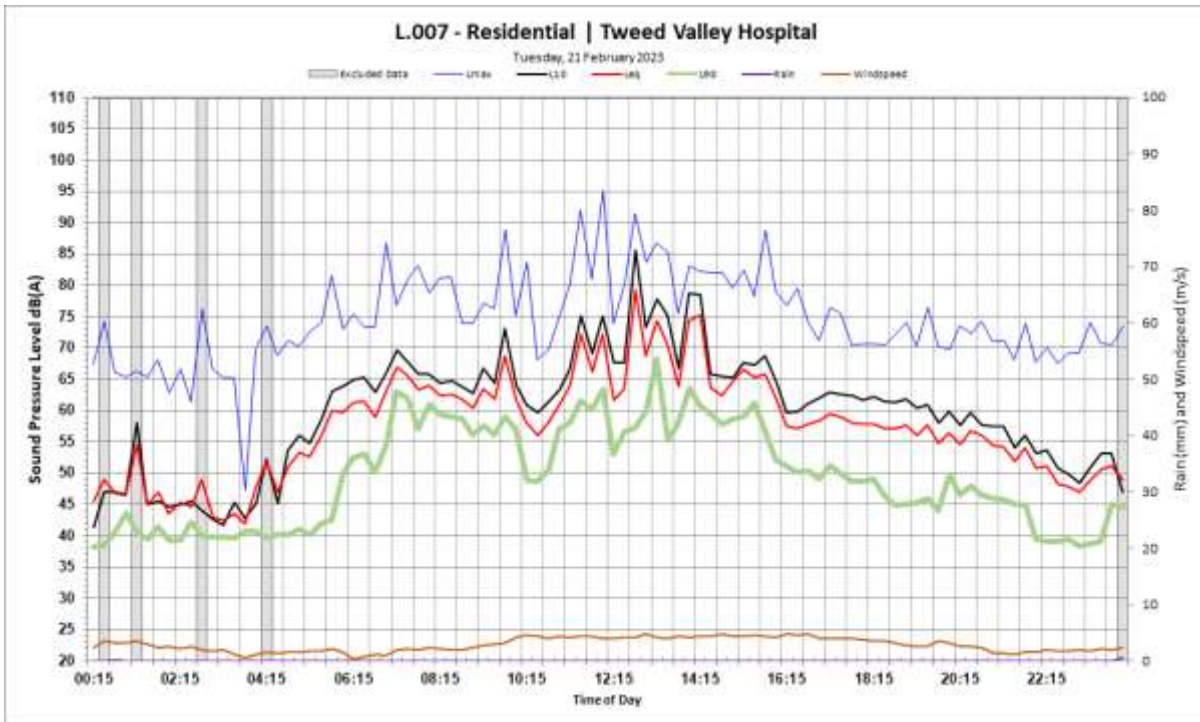


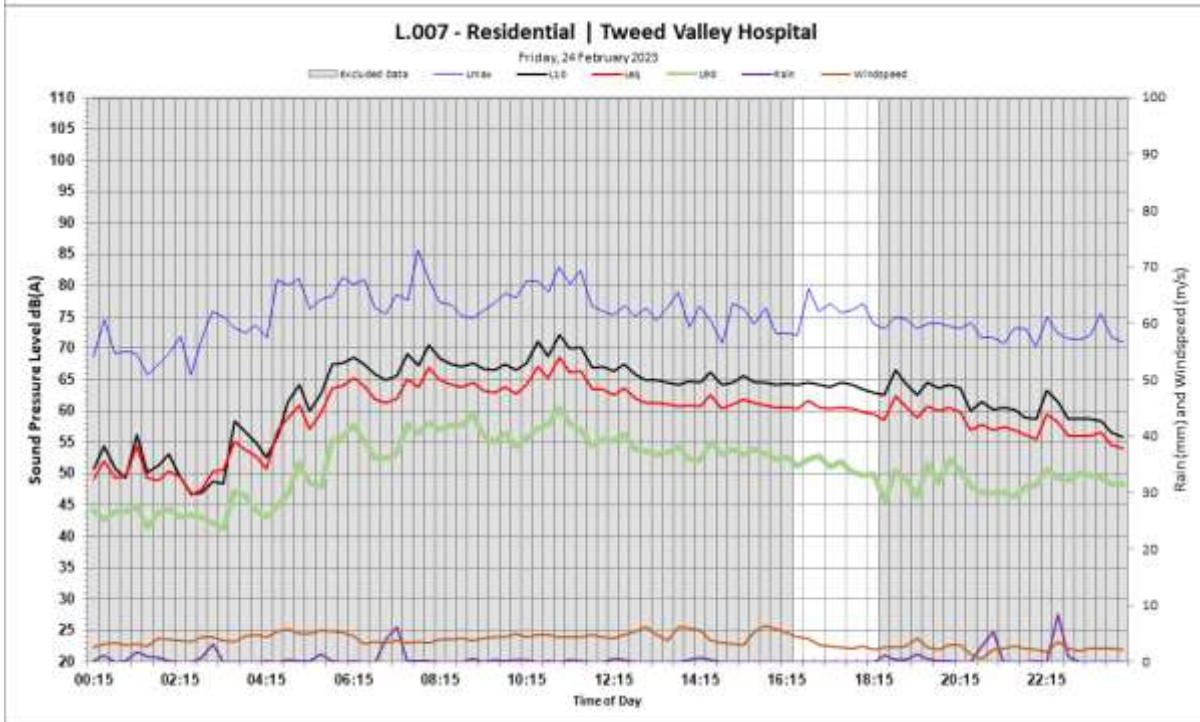
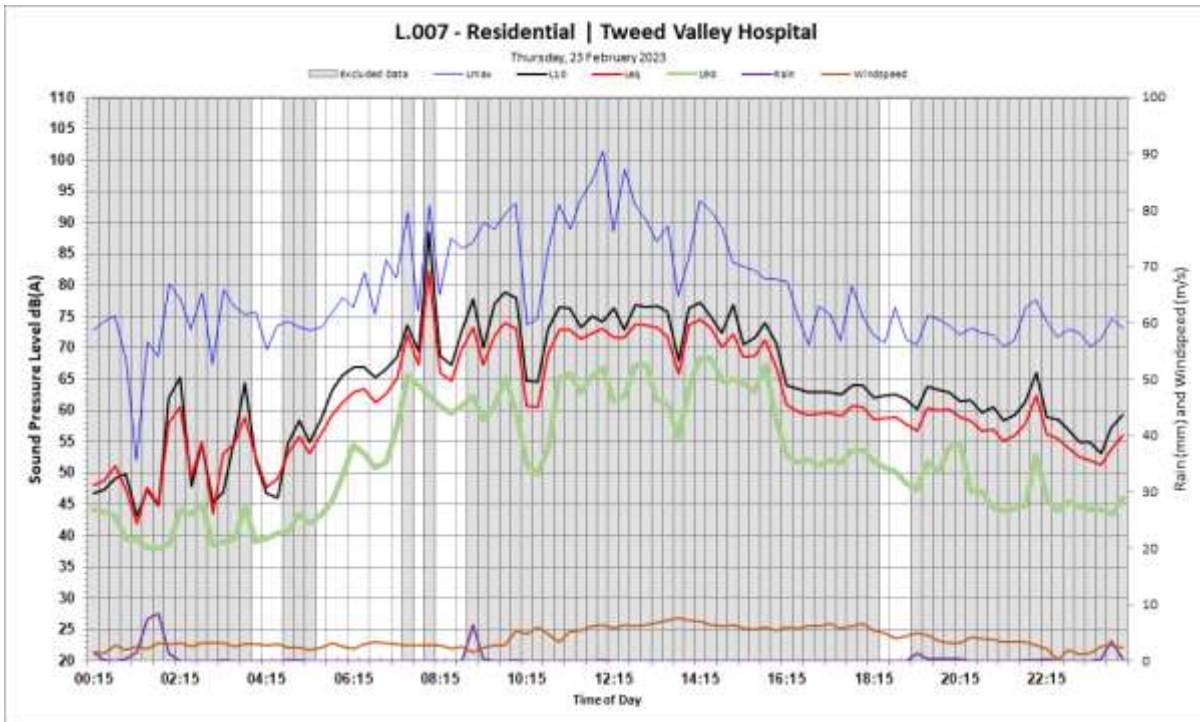


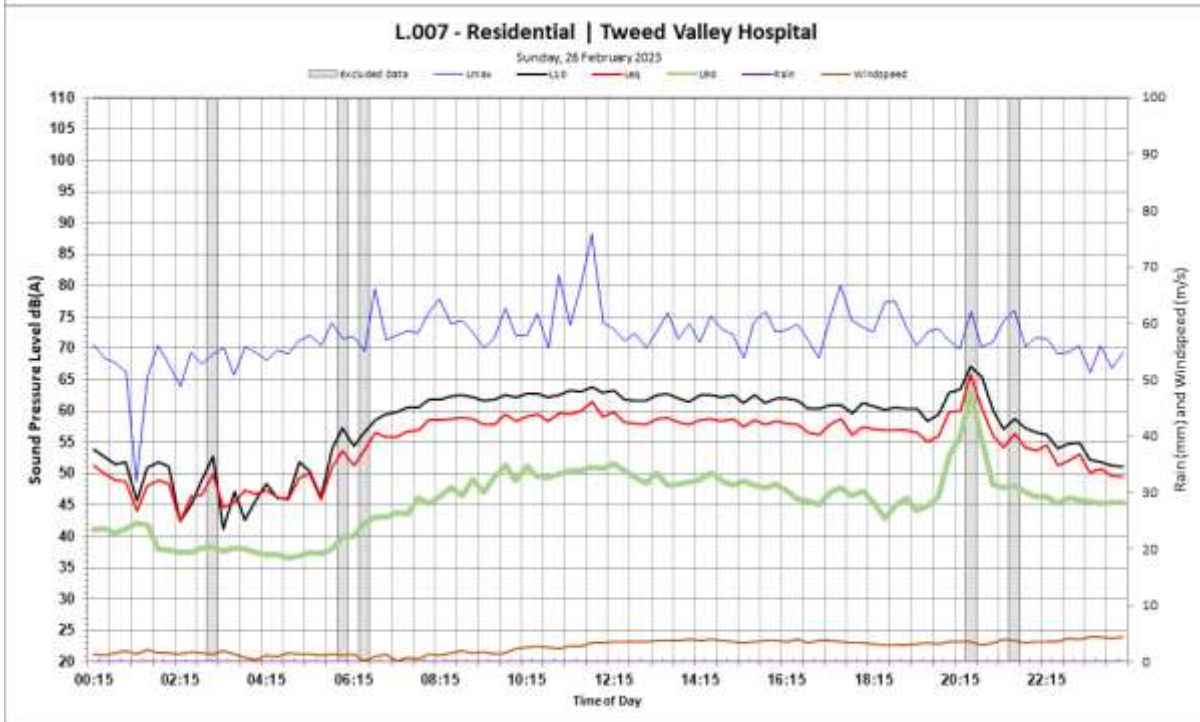
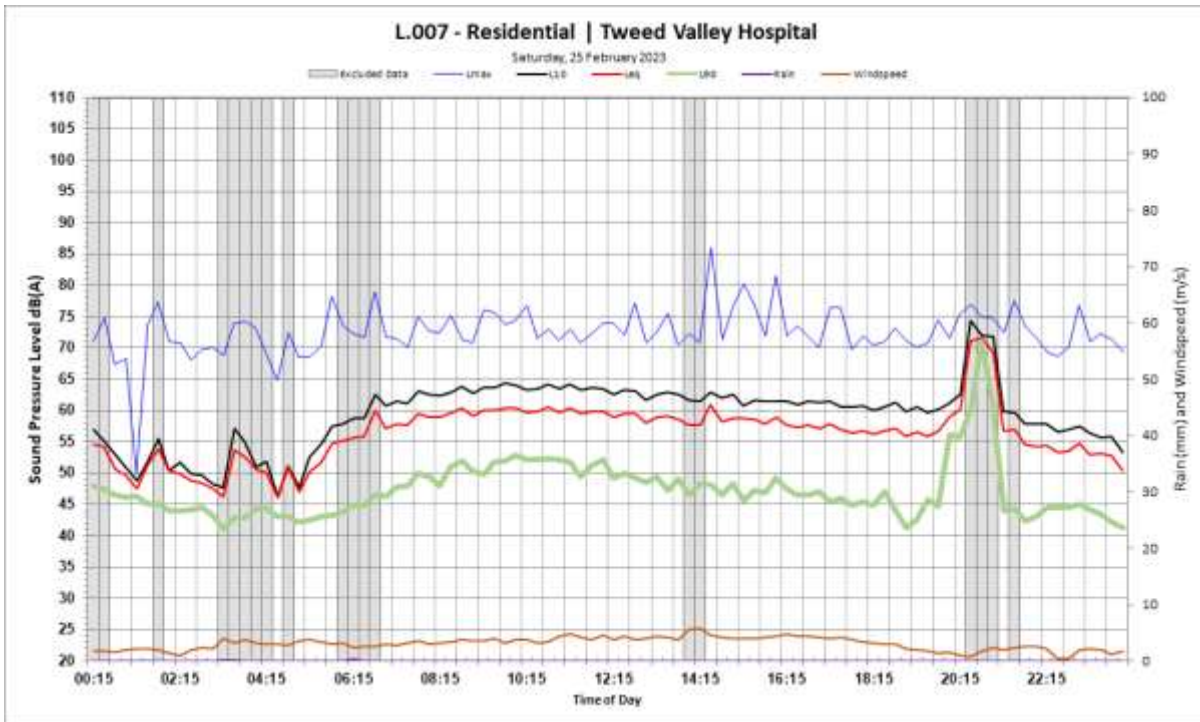


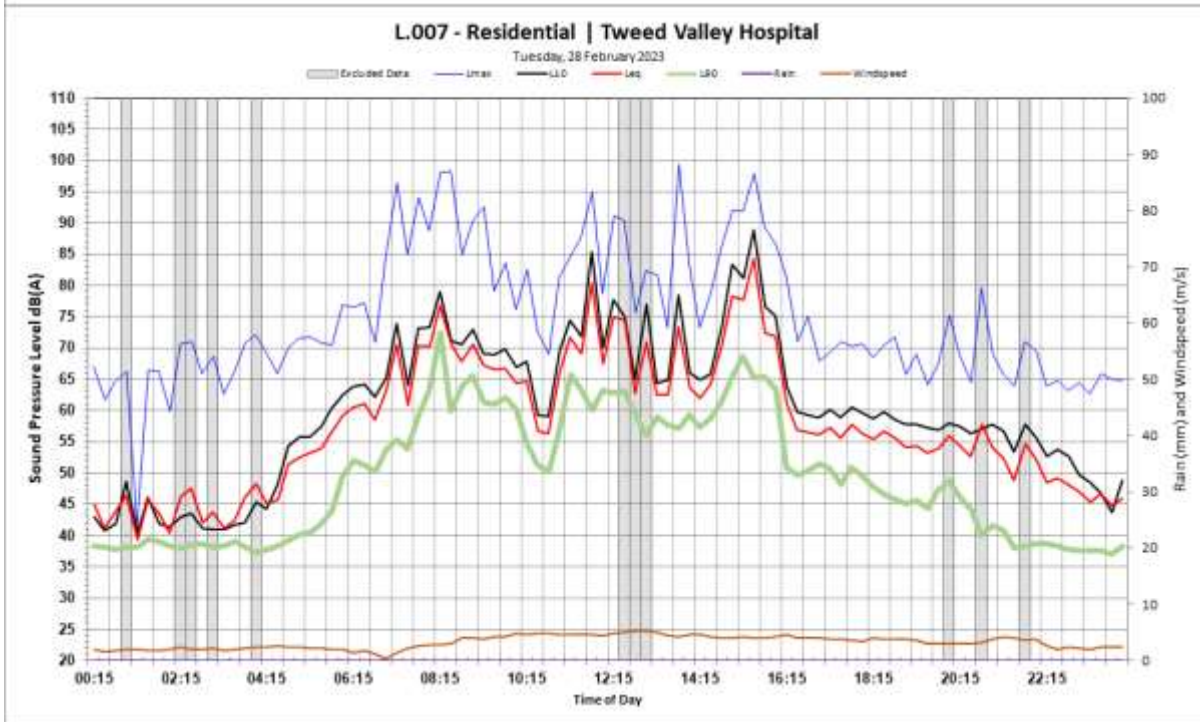
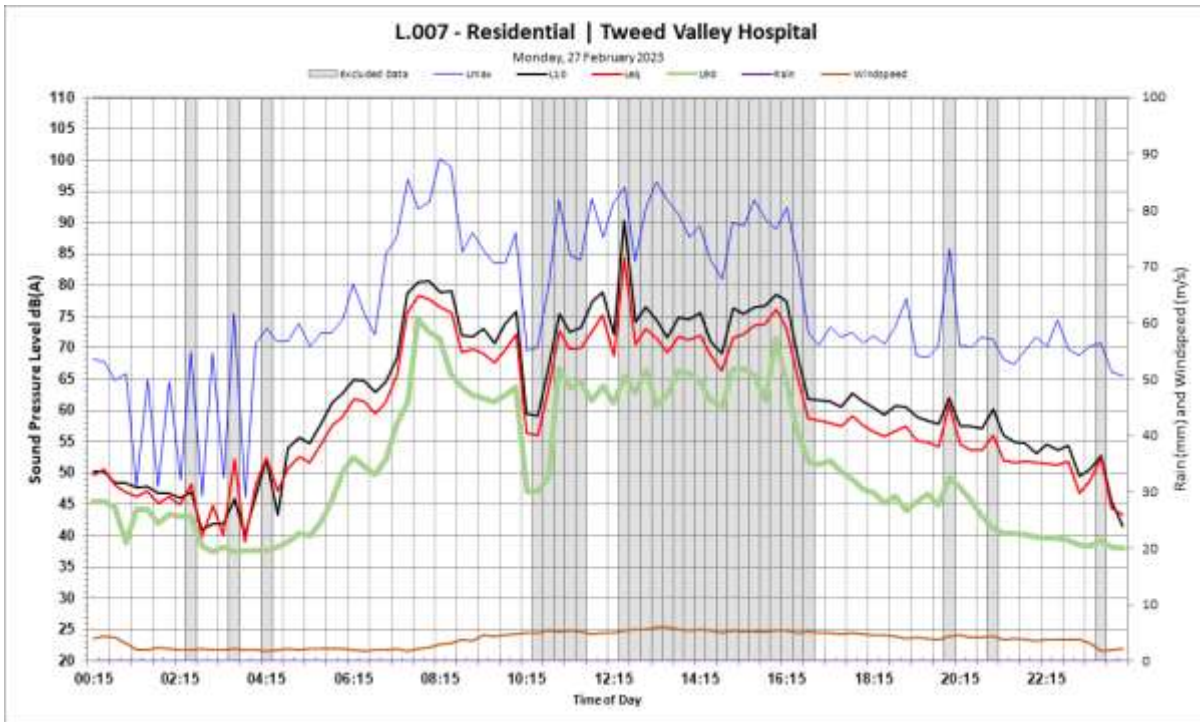














Further details regarding ADE's services are available via

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