

Muswellbrook Hospital Redevelopment Stage 3 - Community Health Relocation

Construction Noise and Vibration Management Plan

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1 INTRODUCTION

Acoustic Logic has been engaged to prepare a noise and vibration management plan for the construction phase of the stage 3 redevelopment of Muswellbrook hospital.

This document presents a discussion of the processes which will be followed in order to manage the noise and vibration from the proposed construction works and will be referenced against the following:

- NSW EPA '*Interim Construction Noise Guideline*' (ICNG);
- Australian Standard AS2107:2016;
- Australian Standard AS2436:2010 "*Guide to Noise Control on Construction, Maintenance and Demolition Sites*";
- DIN 4150, '*Vibration in Buildings (1999-02)*';
- EPA "*Assessing Vibration: A technical guideline*"; and
- ASHRAE Handbook 2007.

The principal issues, which will be addressed in this report, are:

- Identification of sensitive receivers near to the construction work zone.
- Description of hours of work and what work will be undertaken.
- Identification of the noise and vibration standards which will be applicable to this project.
- Identify likely sources of noise generation and predicted noise levels at nearby development and sensitive receiving locations.

Formulation of a strategy for construction to comply with the standards identified in the above point.

2 SITE DESCRIPTION

The land uses surrounding the proposed stage 3 redevelopment community health relocation of Muswellbrook Hospital are existing hospital departments within Muswellbrook Hospital, residential receivers to the south, east and west of Muswellbrook Hospital, commercial receiver to the south and 'Goodstart Early Learning Muswellbrook' childcare centre to the south-west. Site investigation has been carried out and the nearest potentially most affected receivers are:

- **Receiver 1:** Existing hospital departments within Muswellbrook Hospital, which include recovery bays and an operating theatre (See Figure 1 for a mark-up of the receiver locations).
- **Receiver 2:** Existing hospital departments within Muswellbrook Hospital on the ground floor, which include general x-ray imaging, ultrasound and dental surgery rooms. (See Figure 2 for a mark-up of the receiver locations).
- **Receiver 3:** Residential receivers to the south, across Brentwood Street at 21, 23, 27 and 29 Brentwood Street, Muswellbrook.
- **Receiver 4:** Commercial receiver to the south, across Brentwood Street at 25 Brentwood Street, Muswellbrook.
- **Receiver 5:** Residential receivers to the east, across Brecht Street at 63, 65, 67, 69, 73 & 75 Brecht Street, Muswellbrook and 38 Brentwood Street, Muswellbrook.
- **Receiver 6:** 'Goodstart Early Learning Muswellbrook' child care centre to the south-west at 14/18 Brentwood Street, Muswellbrook.
- **Receiver 7:** Residential receivers to the west, across Doyle Street at 1 and 2A Doyle Lane and 4 Doyle Street, Muswellbrook.

See Figure 3 below for a site survey and nearest sensitive receivers.

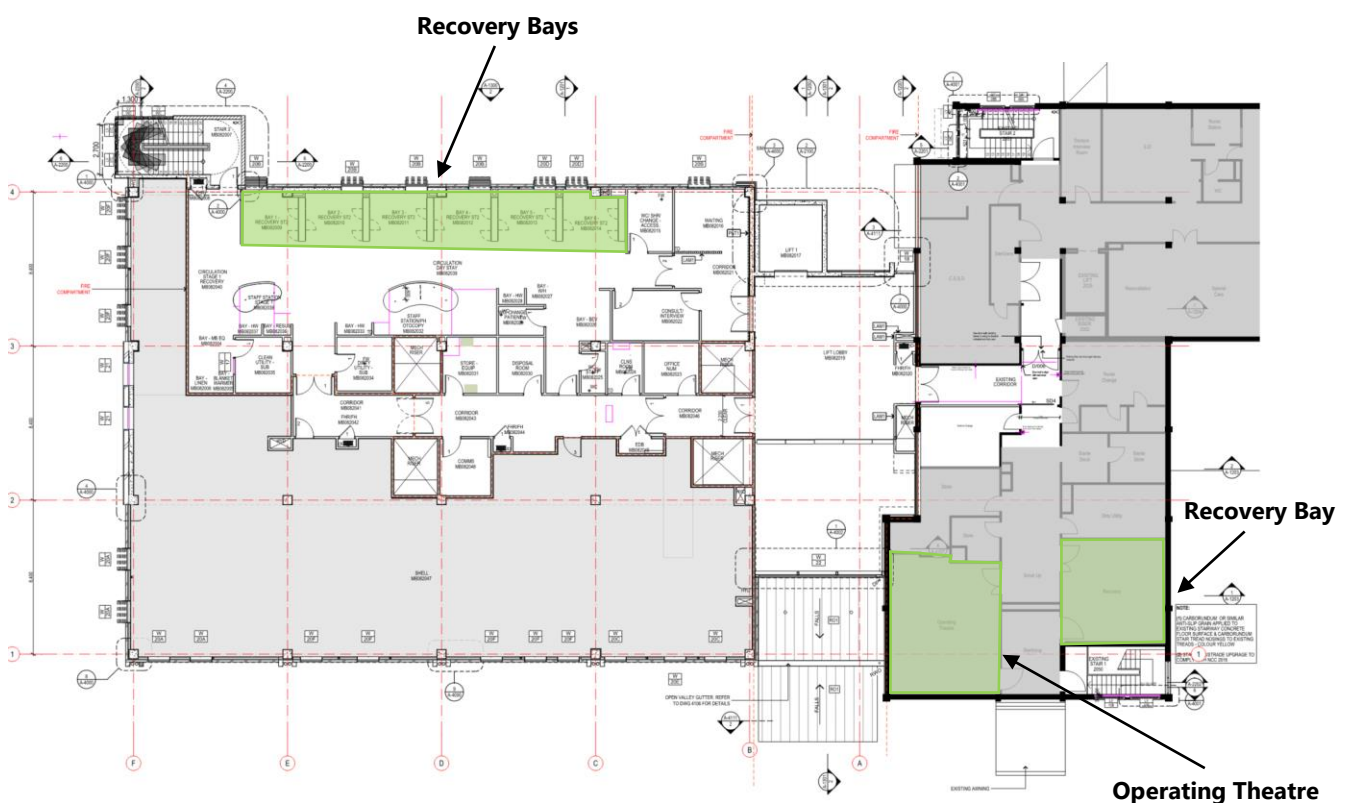
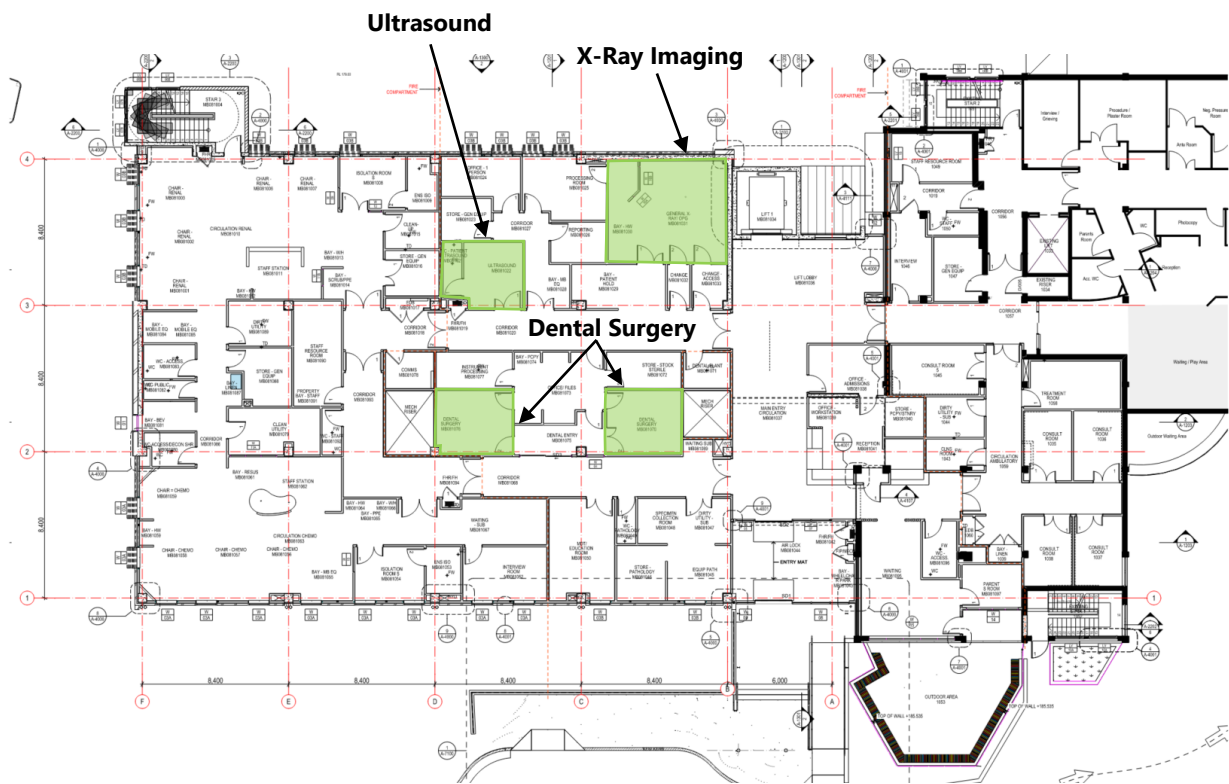


Figure 1: Existing Level 1 Hospital Receivers within Muswellbrook Hospital



Approximate Location of Community Health Relocation Project Site



● = Unattended Noise Monitor

Figure 3: Nearest Sensitive Receivers

- = Child Care Centre Receiver
- = Residential Receiver
- = Commercial Receiver
- = Hospital Receiver

3 CONSTRUCTION ACTIVITIES AND PROPOSED WORKS

The information provided to this office of the primary noise producing activities and proposed works associated with the stage 3 redevelopment of the hospital are as follows below:

Proposed Works:

The proposed activity comprises of the following:

- Internal additions/alterations including fit out of the Lower Ground Floor shell space retained from the Stage 2 Redevelopment for the relocation of community health consult/clinical spaces.
- Associated works broadly comprising of civil engineering works, external footpath for fire egress purposes and plant reconfiguration within existing plant enclosures.

Plant and Equipment:

- Scaffolding and access platforms.
- Articulated and fixed trucks.
- Excavator with bucket attachment.
- Demolition saw.
- General power tools.

See Figure 4 below for a location and staging plan provided to this office.

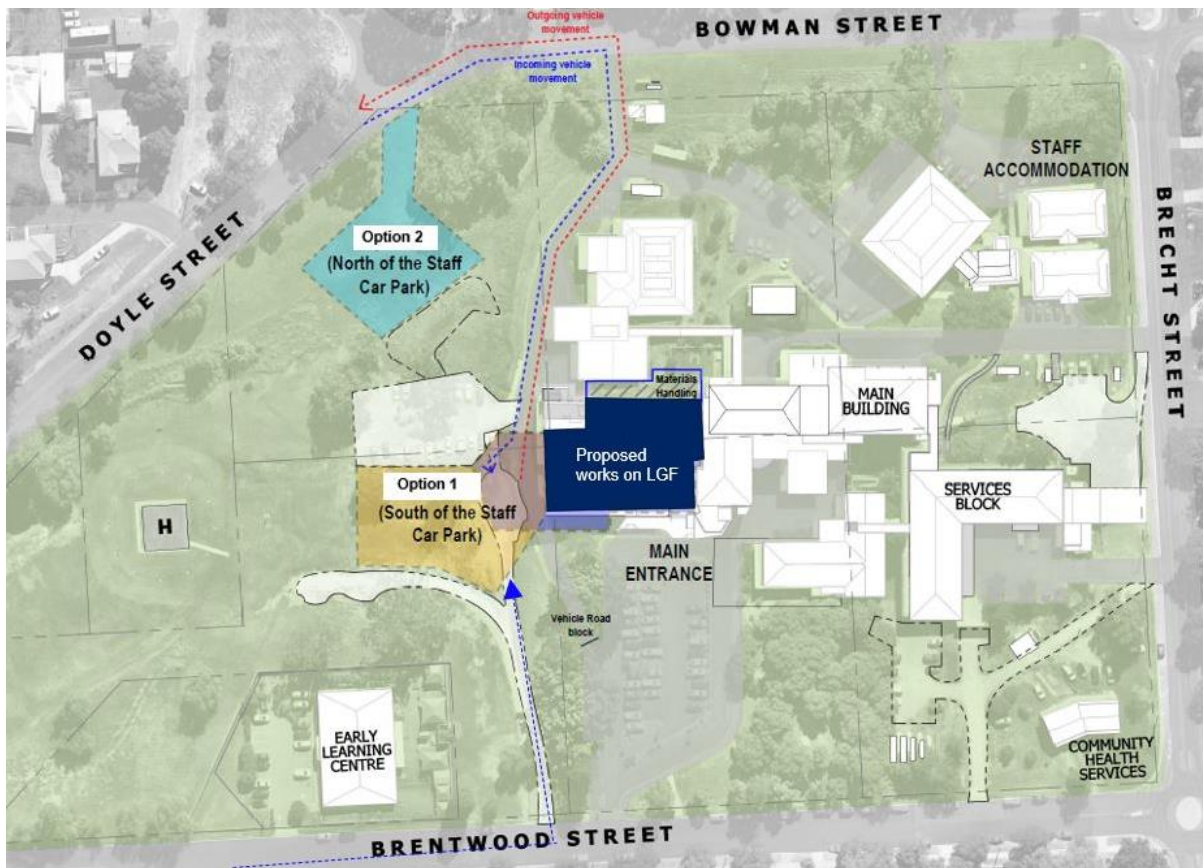


Figure 4: Indicative location and staging plan for Main Works

4 HOURS OF WORK

4.1 PROPOSED HOURS OF WORK

The above scope of work is proposed to be undertaken during the following time periods based on the 'Preliminary Construction Management Plan – Main Works' provided to this office:

Monday to Friday: 7:00am to 5:00pm;

Saturday: 8:00am to 1:00pm; and

Sunday/Public Holidays: No Works.

See Figures 1-3 for a detailed location where the construction works are to be undertaken and the nearest surrounding receivers to the stage 3 redevelopment construction work zone.

5 BACKGROUND NOISE LEVELS

5.1 UNATTENDED NOISE MONITORING

An unattended long term background noise survey has been carried out by this office. Background noise levels which will be used as a basis for this assessment are detailed in the following sections.

5.1.1 Measurement Equipment

Unattended noise monitoring was conducted using one (1) Acoustic Research Laboratories Pty Ltd noise logger. The logger was programmed to store 15-minute statistical noise levels throughout the monitoring period. The equipment was calibrated at the beginning and the end of each measurement using a Rion NC-73 calibrator; no significant drift was detected. All measurements were taken on A-weighted fast response mode.

5.1.2 Measurement Location

An unattended background noise monitor was installed along the eastern boundary of the existing Muswellbrook Hospital, adjacent to the residential receivers situated to the east along Brecht Street. For a detailed monitor location, refer to Figure 3.

5.1.3 Measurement Period

Unattended noise monitoring was conducted from Wednesday, 4th May to Wednesday, 11th May 2022.

5.1.4 Measured Background Noise Levels

The background noise levels established from the unattended noise monitoring are detailed in Table 1 below.

5.1.5 Unattended Noise Measurements

NSW EPA's RBL assessment procedure requires determination of background noise level for each day (the ABL) then the median of the individual days as set out for the entire monitoring period.

Appendix 1 provides the results of the unattended background noise monitoring. Weather affected data was excluded from the assessment. The processed Rating Background Noise Levels (lowest 10th percentile noise levels during operation time period) are presented in Table 1 below.

Table 1 – Unattended Noise Monitor - Rating Background Noise Level

| Date | Daytime Rating Background Noise Levels (L ₉₀) |
|--------------------------------------|---|
| Wednesday, 4 th May 2022 | - |
| Thursday, 5 th May 2022 | 38 |
| Friday, 6 th May 2022 | 40 |
| Saturday, 7 th May 2022 | 39 |
| Sunday, 8 th May 2022 | 34 |
| Monday, 9 th May 2022 | 38 |
| Tuesday, 10 th May 2022 | 39 |
| Wednesday, 11 th May 2022 | 41 |
| Median | 39 |

Note: Items marked “-” above either did not record data through the entire period due to the monitor being installed prior during or after the period or were weather affected for more than 20% of the time period and therefore have been excluded.

5.2 NOISE MANAGEMENT LEVEL

Establishment of criteria for construction noise requirements will be in accordance with the following documents.

- NSW Environmental Protection Authority, 'Interim Construction Noise Guideline';
- Australian Standard AS2107:2016; and
- Australian Standards AS2436:2010 Guide to Noise Control on Construction, Maintenance and Demolition Sites.

5.2.1 NSW EPA Interim Construction Noise Guideline

Given the scale of the proposed works, the “quantitative” assessment procedure, as outlined in the Interim Construction Noise Guideline (ICNG) will be used (as opposed to the simpler “qualitative” assessment method outlined in the guidelines). The quantitative assessment method requires:

- Determination of noise generation management levels (based on background noise levels on site).
- Prediction of operational noise levels at nearby development.
- If necessary, recommendation of noise controls strategies in the event that compliance with noise emission management levels is not possible.

5.2.1.1 At Residential Receivers

EPA guidelines adopt differing strategies for noise control depending on the predicted noise level at the nearest residences and the time of day:

Recommended Standard Hours

Monday to Friday (7am – 5pm) & Saturday (8am – 1pm)

- “Noise affected” level. Where construction noise is predicted to exceed the “noise affected” level at a nearby residence, the proponent should take reasonable/feasible work practices to ensure compliance with the “noise affected level”. For residential properties, the “noise affected” level occurs when construction noise exceeds ambient levels by more than 10dB(A)_{Leq(15min)}.

- *“Highly noise affected level”*. Where noise emissions are such that nearby properties are “highly noise affected”, noise controls such as respite periods should be considered. For residential properties, the “highly noise affected” level occurs when construction noise exceeds 75dB(A)_{Leq(15min)} at nearby residences.

Table 1 – Construction Noise Management Levels to Residential Receivers

| Location | Recommended Standard Hours “Noise Affected” Level - dB(A) _{Leq(15min)} | “Highly Noise Affected” Level - dB(A) _{Leq(15min)} |
|-----------------------|---|---|
| Residential Receivers | BG 39 + 10 = 49 | 75 |

5.2.1.2 To Commercial Receivers

Section 4.1.3 *“Commercial and industrial premises”* of the ICNG outlines the following external management noise levels to the most-affected occupied point of the premises:

Table 2 – Noise Management Level for Commercial Premises (ICNG)

| Space | Management Level dB(A) _{Leq (15 min)} |
|----------------------|--|
| Commercial Receivers | 70 |

5.2.1.3 To Hospital Noise Receivers

Table 3 of the ICNG outlines the following management noise levels to internal areas of hospital buildings:

Table 3 – Noise Management Level for Hospital Buildings (ICNG)

| Space | Internal Management Level dB(A) _{Leq (15 min)} |
|--|---|
| Within Hospital Wards and operating theatres | 45 |

The ICNG does not have management noise levels for other areas of the nearby hospital receivers (offices, consulting rooms etc.) Section 4.1.3 of the ICNG states:

“4.1.3 Commercial and industrial premises

... The proponent should undertake a special investigation to determine suitable noise levels on a project-by-project basis; the recommended ‘maximum’ internal noise levels in AS 2107 Acoustics – Recommended design sound levels and reverberation times for building interiors may assist in determining relevant noise levels (Standards Australia 2000).”

5.2.2 Australian Standard AS2107:2016

Construction noise management levels for noise sensitive spaces in the nearby hospital buildings not covered in the ICNG will be based on the maximum recommended noise levels presented in section AS2107:2016. These are presented in the table below:

Table 4 – Noise Management Level for Hospital Buildings (Internal - AS2107:2016)

| Space | Management Level dB(A)L_{eq} (15 min) |
|--------------------------------|---|
| Bedroom Wards | 45 |
| Consulting Rooms | 45 |
| Treatment Rooms/Dental Surgery | 45 |
| Office Areas | 45 |
| Operating Theatres | 50 |
| X-Ray Areas/Ultrasound | 50 |

5.2.2.1 To Child Care Centre Receivers

Section 4.1.3 “Commercial and industrial premises” of the ICNG outlines the following with regard to other noise-sensitive businesses including childcare centres:

‘The proponent should undertake a special investigation to determine suitable noise levels on a project-by-project basis; the recommended ‘maximum’ internal noise levels in AS 2107 Acoustics – Recommended design sound levels and reverberation times for building interiors may assist in determining relevant noise levels (Standards Australia 2000).

As AS2107:2016 does not stipulate any recommended maximum internal noise levels for childcare centres, this office will adopt the noise criteria typically imposed for noise impacts from road, rail traffic and industry for internal activity/sleeping and outdoor play/activity areas of childcare centres presented in the ‘Association of Australasian Acoustical Consultants (AAAC) ‘Guideline for Child Care Centre Acoustic Assessment, Version 3.0’ which states:

‘The $L_{Aeq,1hr}$ noise level from road traffic, rail or industry at any location within the outdoor play or activity area during the hours when the Centre is operating should not exceed 55dB(A).’

‘The $L_{Aeq,1hr}$ noise level from road traffic, rail or industry at any location within the indoor activity or sleeping areas of the Centre during hours when the centre is operating shall be capable (ie with doors and / or windows closed) of achieving 40dB(A) within indoor activity areas and 35dB(A) in sleeping areas.

Based on the above, the external noise management level for the outdoor play/activity areas will be 55dB(A) L_{eq} (15 min) with an internal noise management level of 40dB(A) L_{eq} (15 min) for activity rooms and 35dB(A) L_{eq} (15 min) for sleeping areas.

5.2.3 Australian Standard AS2436:2010 “Guide to noise control on construction, maintenance and demolition sites”

Australian Standard AS2436 provides guidance on noise and vibration control in respect to construction and demolition sites, and the preparation of noise and vibration management plans, work method statements and impact studies. The Standard states that:

- “Some construction and demolition activities are by their very nature noisy. The authorities responsible for setting noise level criteria for essential works will take note of the constraints imposed by such activities, especially when they are of short duration.”
- Construction, demolition and maintenance works pose different problems of noise and vibration control when compared with most other types of industrial activity, since
 - (a) they are mainly carried on in the open;
 - (b) they are often temporary in nature although they may cause considerable disturbance whilst they last;
 - (c) the noise and vibration arise from many different activities and kinds of plant, and their intensity and character may vary greatly during different phases of the work; and
 - (d) the sites cannot be separated by planning control, from areas that are sensitive to noise and vibration.

The standard provides advice and guidelines for the prediction of impacts and the methods available to manage impacts. It guideline promulgates feasible and reasonable mitigation strategies and controls, and stakeholder liaison, in the effort to reach a realistic compromise between site activities and impacts on neighbouring properties.

Based on the above, the following procedure will be used to assess noise emissions:

- Predict noise levels produced by typical construction activities at the sensitive receivers.
- Develop a suitable noise criterion based on the NSW Environmental Protection Authority Interim Construction Noise Guideline.
- Adopt management conditions as per AS 2436 in the event of a non-compliance.

5.2.4 Summarised Noise Management Levels

The summarised noise management levels for the proposed construction activities are presented in the table below.

Table 5 – Summarised Noise Management Levels

| Location | Management Level dB(A)L_{eq} (15 min) |
|--------------------------------|--|
| Residential Receivers | <u>Recommended Standard Hours</u> "Noise Affected" Level - 49 "Highly Noise Affected" Level – 75 <u>Outside Recommended Standard Hours</u> "Noise Affected" Level - 44 |
| Bedroom Wards | 45 (Internal) |
| Consulting Rooms | |
| Treatment Rooms/Dental Surgery | |
| Office Areas | |
| Operating Theatres | |
| X-Ray Areas/Ultrasound | 50 (Internal) |
| Commercial Receiver | 70 |
| Childcare centre Receiver | 55 (External Outdoor Play or Activity Area) 40 (Internal Indoor activity area with windows/doors closed) 35 (Internal sleeping area with windows/doors closed) |

5.3 CONSTRUCTION VIBRATION CRITERIA

Vibration criteria for the nearest receivers will be based on the following documents:

- DIN 4150, 'Vibration in Buildings (1999-02)';
- EPA "Assessing Vibration: A technical guideline"; and
- ASHRAE Handbook 2007.

5.3.1 DIN 4150

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The criteria presented in DIN 4150-3 (1999-02) are presented in the table below.

It is noted that the peak velocity is the absolute value of the maximum of any of the three orthogonal component particle velocities as measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

Table 6 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

| TYPE OF STRUCTURE | | PEAK PARTICLE VELOCITY (mms ⁻¹) | | | |
|-------------------|---|---|--------------|---------------|------------------------------------|
| | | At Foundation at a Frequency of | | | Plane of Floor of Uppermost Storey |
| | | < 10Hz | 10Hz to 50Hz | 50Hz to 100Hz | All Frequencies |
| 1 | Buildings used in commercial purposes, industrial buildings and buildings of similar design | 20 | 20 to 40 | 40 to 50 | 40 |
| 2 | Dwellings and buildings of similar design and/or use | 5 | 5 to 15 | 15 to 20 | 15 |
| 3 | Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order) | 3 | 3 to 8 | 8 to 10 | 8 |

5.3.2 Assessing Amenity

Table 2.2 of EPA "Assessing Vibration: A technical guideline" specified the following vibration goal for human comfort:

Table 7 – Preferred and Maximum Weighted RMS Values for Vibration Acceleration (m/s^2) 1-80 Hz

| Location | Assessment Period | Preferred Values Z-axis | Preferred Values X & Y-axis | Maximum Values Z-axis | Maximum Values X & Y-axis |
|-----------------------------|-------------------|----------------------------|--------------------------------|--------------------------|------------------------------|
| Continuous Vibration | | | | | |
| Critical Areas | Day time | 0.005 | 0.0036 | 0.010 | 0.0072 |
| Residences | Day time | 0.010 | 0.0071 | 0.020 | 0.014 |
| Office | Day time | 0.020 | 0.014 | 0.040 | 0.028 |
| Impulsive Vibration | | | | | |
| Critical Areas | Day time | 0.005 | 0.0036 | 0.010 | 0.0072 |
| Residence | Day time | 0.3 | 0.21 | 0.6 | 0.42 |
| Office | Day time | 0.64 | 0.46 | 1.28 | 0.92 |

Acceptable values for intermittent vibration shall comply with the requirements in Table 2.4 of EPA "Assessing Vibration: A technical guideline" detailed as below.

Table 8 - Acceptable Vibration Dose Values for Intermittent Vibration ($\text{m/s}^{1.75}$)

| Location | Day time preferred value | Day time maximum value |
|----------------|--------------------------|------------------------|
| Critical Areas | 0.10 | 0.20 |
| Residences | 0.20 | 0.40 |
| Office | 0.40 | 0.80 |

5.3.3 Hospital Specific Vibration Limits

This office has been advised that vibration sensitive equipment is located within the existing Muswellbrook hospital.

No specific allowable vibration levels have been provided to this office. Given this, the appropriate vibration curve from the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Handbook based on the equipment type will be used.

The ASHRAE Handbook specifies vibration levels associated with potential disruption to the use of sensitive equipment within a building. The maximum vibration velocities [mm.s^{-1}] recommended from 1-100Hz is given in Figure 37 of the ASHRAE used in conjunction with recommended equipment requirements curves given in table 46. Figure 37 and table 46 from the 2007 ASHRAE document is presented below in Figure 7 and Table 9 respectively.

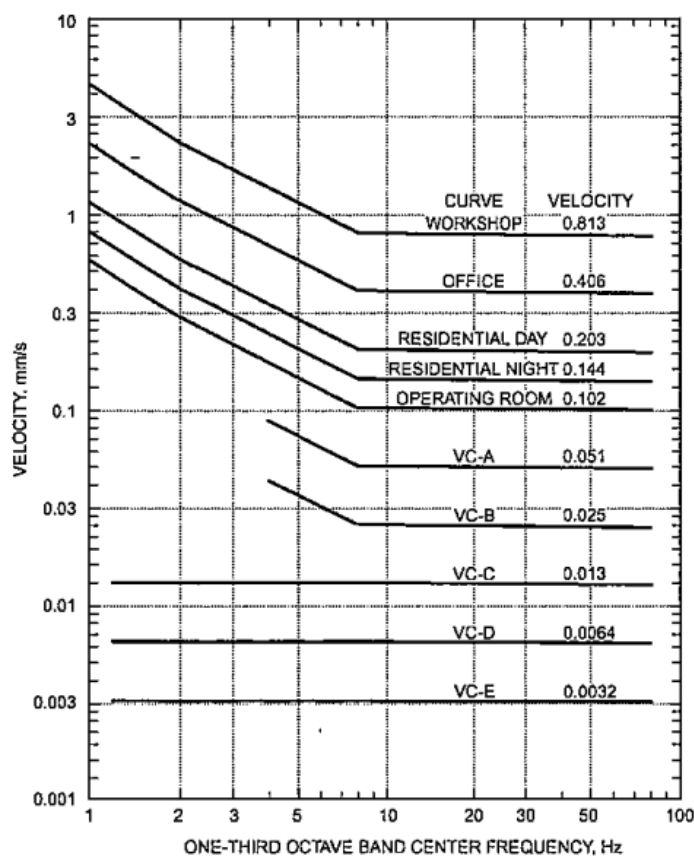


Fig. 37 Building Vibration Criteria for Vibration Measured on Building Structure

Figure 7 – Fig. 37 from 2007 ASHRAE Handbook: Vibration Criteria Curves

Table 9 – Tab. 46 from 2007 ASHRAE Handbook: Equipment Vibration Criteria

| Equipment Requirements | Curve |
|---|---------------------------|
| Adequate for computer equipment, probe test equipment, and microscopes less than 40x magnification | 0.203 (Residential – day) |
| Bench Microscopes up to 100x magnification; laboratory robots | 0.102 (Operating Room) |
| Bench microscopes up to 400x magnification; optical and other precision balances; coordinate measuring machines; metrology laboratories; optical comparators; microelectronics manufacturing equipment; proximity and projection aligners, etc. | 0.051 (VC – A) |
| Microsurgery, eye surgery, neurosurgery; bench microscopes at magnification greater than 400x magnification; optical equipment on isolation tables; microelectronic manufacturing equipment, such as inspection and lithography equipment (including steppers) to 3mm line widths | 0.025 (VC – B) |
| Electron microscopes up to 30,000x magnification; microtomes; magnetic resonance imagers; microelectronics manufacturing equipment, such as lithography and inspection equipment to 1mm detail size | 0.013 (VC – C) |
| Electron microscopes at magnification greater than 30,000x magnification; mass spectrometers; cell implant equipment; microelectronic manufacturing equipment such as, aligners, steppers and other critical equipment for photolithography with line widths of 1/2µm; includes electron beam systems | 0.0064 (VC – D) |
| Un-isolated laser and optical research systems; microelectronics manufacturing equipment, such as aligners, steppers and other critical equipment for photolithography with line widths of 1/4µm; includes electron beam systems | 0.0032 (VC – E) |

a. See Figure for corresponding vibration curve.

We note that that Table 46 of ASHRAE does not have any vibration criteria for X-Ray imaging machines. **Given this, vibration criteria for the X-ray imaging will be based on the “Operating Room” Curve of Figure 37 of the ASHRAE vibration criteria.**

All vibration monitoring results recorded on site are presented against the vibration curves listed above. The appropriate level of vibration will ultimately be determined by the staff operating the equipment and whether or not the level of distortion created by the construction works is acceptable. We note that the VC curves are a representation of the level of disruption to the activities and/or operations undertaken by the machine and not the limit where damage would be expected to occur to the unit.

5.3.4 Hospital Specific Vibration Limits – Additional Medical Equipment

A site investigation and attended ambient vibration measurements were carried out by this office on Wednesday, 4th May 2022 within Muswellbrook Hospital. The following areas were identified to contain vibration sensitive equipment:

1. Ground Floor

- a. Dental Surgery.
- b. General X-Ray.
- c. Ultrasound.

2. Level 1

- a. Operating Theatre.

Based on the ambient baseline vibration measurements undertaken within the nominated areas above, the following vibration measurements were recorded:

Dental Surgery: 0.02mm/s Peak Particle Velocity (PPV).

General X-Ray: 0.02mm/s Peak Particle Velocity (PPV).

Ultrasound: 0.04mm/s Peak Particle Velocity (PPV).

Operating Theatre: 0.01mm/s Peak Particle Velocity (PPV).

5.3.5 Summarised Recommended Vibration Limits

The summarised vibration criteria are presented in the table below.

Table 10 – Recommended Vibration Limit

| Vibration Receiver | Recommended Vibration Limits PPV (mm/s) |
|-------------------------------------|---|
| Operating Theatre | VC – B Curve of Figure 37 of the ASHRAE vibration criteria |
| X-Ray Imaging Room | “Operating Theatre” Curve of Figure 37 of the ASHRAE vibration criteria |
| Dental Surgery | 0.02 |
| Ultrasound | 0.04 |
| Residential Buildings | 5 |
| Commercial/Other Hospital Buildings | 20 |
| Childcare Centre | 20 |

6 CONSTRUCTION NOISE EMISSION ASSESSMENT

6.1 PROPOSED SCOPE OF WORK DURING CONSTRUCTION PERIOD

The proposed activity comprises of the following:

Proposed Works:

The proposed activity comprises of the following:

- Internal additions/alterations including fit out of the Lower Ground Floor shell space retained from the Stage 2 Redevelopment for the relocation of community health consult/clinical spaces.
- Associated works broadly comprising of civil engineering works, external footpath for fire egress purposes and plant reconfiguration within existing plant enclosures.

Plant and Equipment:

- Scaffolding and access platforms.
- Articulated and fixed trucks.
- Excavator with bucket attachment.
- Demolition saw.
- General power tools.

6.2 PROPOSED CONSTRUCTION HOURS OF WORK

The above scope of work is proposed to be undertaken during the following periods:

Monday to Friday: 7:00am to 5:00pm;

Saturday: 8:00am to 1:00pm; and

Sunday/Public Holidays: No Works.

See Figures 1-4 for a detailed locations where the construction works are to be undertaken and the nearest surrounding receivers to the project site.

6.3 ACTIVITIES TO BE CONDUCTED AND THE ASSOCIATED NOISE SOURCES

Preliminary construction methodology has been discussed with Health Infrastructure to determine a typical worst-case scenario for noise emissions from construction activities associated with the stage 3 redevelopment of Muswellbrook Hospital. The typical worst-case scenarios and associated Sound Power Level noise data is detailed below:

Construction Stage

1 x Excavator with Bucket Attachment.

1 x Concrete Truck.

1 x Concrete Pump.

1 x Demolition Saw.

1 x Semi-Trailer.

1 x Builder's Hoist.

Powered Hand Tools.

Table 11 – Sound Power Levels of the Proposed Equipment

| EQUIPMENT / PROCESS | SOUND POWER LEVEL dB(A) |
|----------------------------------|--------------------------------|
| Excavator with Bucket Attachment | 114 |
| Concrete Truck | 105 |
| Concrete Pump | 105 |
| Demolition Saw | 118* |
| Semi-Trailer | 105 |
| Builders Hoist | 105 |
| Powered Hand Tools (Up to 6) | 100 |

*** Includes 5dB(A) addition for characteristics of noise source.**

The noise levels presented in the above table are derived from the following sources, namely:

- On site measurements;
- Table A1 of Australian Standard 2436-2010 & Table A1 of Australian Standard 2436-2010; and
- Data held by this office from other similar studies.

6.4 PRELIMINARY NOISE ASSESSMENT

6.4.1 Methodology

Noise from the loudest typical construction activities have been predicted to the nearest most affected sensitive receivers. The predicted noise levels are presented in this section and are based on the areas on site in which the plant is likely to be used.

Where the position of the construction activity is variable, a range of predicted noise levels is presented to take into account the change in noise impact depending on where in the site the work is conducted.

Predictions take into account:

- The distance between the noise source and the receiver; and
- The screening effect provided by barriers or building structures (where relevant).

6.4.2 Predicted Noise Levels

Predicted noise levels for each receiver are presented within the tables below.

For external receivers surrounding the Muswellbrook Hospital and where external receivers have an internal noise management level, it is assumed the existing Muswellbrook Hospital façade and façade of external receivers to both have an estimated acoustic performance of R_w30 .

Table 12 – Predicted Noise Generation to Receiver 1

| Activity | Internal Noise Management Level dB(A) L_{eq} (15min) | Predicted Noise Level dB(A) $L_{eq(15min)}$ (Internal Areas) | Below Internal Noise Management Level? |
|--------------------------------------|--|--|---|
| 1 x Excavator with Bucket Attachment | 45 | 38-58 | No – See section 6.5 'Ameliorative Measures' |
| 1 x Concrete Truck | | 30-46 | Marginal |
| 1 x Concrete Pump | | 30-46 | Marginal |
| 1 x Demolition Saw | | 42-62 | No – See section 6.5 'Ameliorative Measures' |
| 1 x Semi-Trailer | | 23-38 | Yes |
| 1 x Builders Hoist | | 31-51 | No – See section 6.5 'Ameliorative Measures' |
| Powered Hand Tools (Up to 6) | | 26-46 | Marginal |

Table 13 – Predicted Noise Generation to Receiver 2

| Activity | Internal Noise Management Level dB(A) L_{eq} (15min) | Predicted Noise Level dB(A) $L_{eq(15min)}$ (Internal Areas) | Below Internal Noise Management Level? |
|--------------------------------------|--|--|---|
| 1 x Excavator with Bucket Attachment | 45 | 38-58 | No – See section 6.5 'Ameliorative Measures' |
| 1 x Concrete Truck | | 30-46 | Marginal |
| 1 x Concrete Pump | | 30-46 | Marginal |
| 1 x Demolition Saw | | 42-62 | No – See section 6.5 'Ameliorative Measures' |
| 1 x Semi-Trailer | | 23-38 | Yes |
| 1 x Builders Hoist | | 31-51 | No – See section 6.5 'Ameliorative Measures' |
| Powered Hand Tools (Up to 6) | | 26-46 | Marginal |

Table 14 – Predicted Noise Generation to Receiver 3

| Activity | Noise Management Level dB(A) L_{eq} (15min) | Predicted Noise Level dB(A) $L_{eq(15min)}$ | Below Noise Management Level? |
|--------------------------------------|--|--|--|
| 1 x Excavator with Bucket Attachment | Recommended Standard Hours "Noise Affected" Level - 49 "Highly Noise Affected" Level – 75 | 60-63 | No – Below 'Highly Noise Affected' level – See section 6.5 'Ameliorative Measures' |
| 1 x Concrete Truck | | 53-56 | |
| 1 x Concrete Pump | | 53-56 | |
| 1 x Demolition Saw | | 64-67 | Yes |
| 1 x Semi-Trailer | | 45-48 | |
| 1 x Builders Hoist | | 54-56 | |
| Powered Hand Tools (Up to 6) | | 49-51 | No – Below 'Highly Noise Affected' level – See section 6.5 'Ameliorative Measures' |

Table 15 – Predicted Noise Generation to Receiver 4

| Activity | Noise Management Level dB(A) L_{eq} (15min) | Predicted Noise Level dB(A) $L_{eq(15min)}$ | Below Noise Management Level? |
|--------------------------------------|---|--|-------------------------------|
| 1 x Excavator with Bucket Attachment | 70 | 60-63 | Yes |
| 1 x Concrete Truck | | 53-56 | Yes |
| 1 x Concrete Pump | | 53-56 | Yes |
| 1 x Demolition Saw | | 64-67 | Yes |
| 1 x Semi-Trailer | | 45-48 | Yes |
| 1 x Builders Hoist | | 54-56 | Yes |
| Powered Hand Tools (Up to 6) | | 49-51 | Yes |

Table 16 – Predicted Noise Generation to Receiver 5

| Activity | Noise Management Level dB(A) L_{eq} (15min) | Predicted Noise Level dB(A) $L_{eq(15min)}$ | Below Noise Management Level? |
|--------------------------------------|---|---|--|
| 1 x Excavator with Bucket Attachment | Recommended Standard Hours "Noise Affected" Level - 49 "Highly Noise Affected" Level – 75 | 56-60 | No – Below 'Highly Noise Affected' level – See section 6.5 'Ameliorative Measures' |
| 1 x Concrete Truck | | 49-53 | |
| 1 x Concrete Pump | | 49-53 | |
| 1 x Demolition Saw | | 60-64 | |
| 1 x Semi-Trailer | | 41-45 | Yes |
| 1 x Builders Hoist | | 50-54 | No – Below 'Highly Noise Affected' level – See section 6.5 'Ameliorative Measures' |
| Powered Hand Tools (Up to 6) | | 45-49 | Yes |

Table 17 – Predicted Noise Generation to Receiver 6 (Outdoor Play Area)

| Activity | AL Noise Management Level dB(A) L_{eq} (15min) | Predicted Noise Level dB(A) $L_{eq(15min)}$ | Below AL Noise Management Level? |
|--------------------------------------|--|---|--|
| 1 x Excavator with Bucket Attachment | 55 | 58-64 | No – See section 6.5 'Ameliorative Measures' |
| 1 x Concrete Truck | | 50-57 | |
| 1 x Concrete Pump | | 50-57 | |
| 1 x Demolition Saw | | 62-68 | |
| 1 x Semi-Trailer | | 43-49 | Yes |
| 1 x Builders Hoist | | 51-58 | No – See section 6.5 'Ameliorative Measures' |
| Powered Hand Tools (Up to 6) | | 46-53 | Yes |

Table 18 – Predicted Noise Generation to Receiver 6 (Internal Activity Area)

| Activity | AL Noise Management Level dB(A) L_{eq} (15min) | Predicted Noise Level dB(A) $L_{eq}(15min)$ | Below AL Noise Management Level? |
|--------------------------------------|--|---|---|
| 1 x Excavator with Bucket Attachment | 40 (Internal) | 33-39 | Yes |
| 1 x Concrete Truck | | 25-32 | Yes |
| 1 x Concrete Pump | | 25-32 | Yes |
| 1 x Demolition Saw | | 37-43 | No |
| 1 x Semi-Trailer | | 18-24 | Yes |
| 1 x Builders Hoist | | 26-33 | Yes |
| Powered Hand Tools (Up to 6) | | 21-28 | Yes |

Table 19 – Predicted Noise Generation to Receiver 6 (Internal Sleeping Area)

| Activity | AL Noise Management Level dB(A) L_{eq} (15min) | Predicted Noise Level dB(A) $L_{eq}(15min)$ | Below AL Noise Management Level? |
|--------------------------------------|--|---|---|
| 1 x Excavator with Bucket Attachment | 35 (Internal) | 33-39 | No – See section 6.5 'Ameliorative Measures' |
| 1 x Concrete Truck | | 25-32 | Yes |
| 1 x Concrete Pump | | 25-32 | Yes |
| 1 x Demolition Saw | | 37-43 | No – See section 6.5 'Ameliorative Measures' |
| 1 x Semi-Trailer | | 18-24 | Yes |
| 1 x Builders Hoist | | 26-33 | Yes |
| Powered Hand Tools (Up to 6) | | 21-28 | Yes |

Table 20 – Predicted Noise Generation to Receiver 7

| Activity | Noise Management Level dB(A) L_{eq} (15min) | Predicted Noise Level dB(A) $L_{eq(15min)}$ | Below Noise Management Level? |
|--------------------------------------|---|---|--|
| 1 x Excavator with Bucket Attachment | <u>Recommended Standard Hours</u> “Noise Affected” Level - 49 “Highly Noise Affected” Level – 75 | 60-63 | No – Below ‘ <i>Highly Noise Affected</i> ’ level – See section 6.5 ‘ <i>Ameliorative Measures</i> ’ |
| 1 x Concrete Truck | | 53-56 | |
| 1 x Concrete Pump | | 53-56 | |
| 1 x Demolition Saw | | 64-67 | |
| 1 x Semi-Trailer | | 45-48 | |
| 1 x Builders Hoist | | 54-57 | |
| Powered Hand Tools (Up to 6) | | 46-50 | Marginal |

6.5 AMELIORATIVE MEASURES

6.5.1 Site Specific Recommendations

- Notification - Prior to commencement of each month, neighbouring receivers and hospital departments should be notified of the anticipated works for that month and the potential noise and vibration generation from the anticipated construction activity.
- High Noise Generating Works:
 - Where high noise generating works are proposed to be undertaken, respite hours should be implemented to reduce the impact on surrounding receivers, namely within the hospital. Limit the use of any required saw cutting or grinding activities to between 8:00am – 12:00pm and 2:00pm - 5:00pm Monday to Friday and between 9:00am - 12:00pm on Saturdays.
- Consultation is recommended to be undertaken with the existing Muswellbrook Hospital departments (Receivers 1 and 2) and the 'Goodstart Early Learning Muswellbrook' child care centre (Receiver 6) prior to undertaking saw cutting to determine a schedule for this activity to be conducted to reduce any adverse noise impact on the existing hospital and the outdoor play area and internal sleeping areas of the child care centre.
- It is recommended to position the builder's hoist along the northern boundary of the project site, away from existing hospital buildings.
- Vehicle Noise - Trucks must turn off their engines during idling to reduce impacts on nearby receivers. Minimise truck reversing. Plant and equipment should be off when not in use.
- Vehicles for construction activity must arrive and depart site within the approved hours of work (7am-5pm Monday to Friday, 8am-5pm Saturdays).
- Deliveries should use straps in place of chains for handling materials wherever possible. Deliveries should be scheduled during less sensitive time periods (After 9am) wherever practical.
- When selecting construction equipment to be used on the project, the noise levels of plant and equipment should be considered, whereby equipment selected has an equivalent or lower sound power level than the predictive sound power levels of equipment maintained within this report.
- A conscientious effort should be made to avoid works near the nearest sensitive receivers wherever feasible. Compounding high generating activities simultaneously near receivers should be avoided where possible.
- All employees, contractors and sub-contractors are to undergo an environmental induction which outlines noise management techniques.
- Unnecessary shouting should be avoided on site, and appropriate signage should be installed to remind workers of their responsibility to reduce noise impacts where feasible. Loud music from radios and stereos is not permitted.
- Materials should be placed gently and not thrown to avoid making crashing noises.
- Non-tonal reversing beepers should be implemented on all construction equipment and mobile plant used regularly on site.

In the event of a complaint, noise management procedure identified in section 8 of this report are to be followed. Notwithstanding above, general management techniques and acoustic treatments are included below which may be implemented on a case-by-case basis to reduce noise emissions to surrounding receivers.

- Vibration monitoring to be conducted as follows:
 - Vibration monitor is to be located in the X-Ray/Ultrasound Room and is to be B+K VMT 4450 or equal (capable of measurement of VC-B vibration levels), and to have SMS/email notification capability.
 - Vibration monitor is to be located in the Dental Surgery and is to be B+K VMT 4450 or equal (capable of measurement of VC-C vibration levels), and to have SMS/email notification capability.

- Vibration monitor is to be located in the Level 1 Operating Theatre and is to be B+K VMT 4450 or equal (capable of measurement of VC-B vibration levels), and to have SMS/email notification capability.

6.6 GENERAL RECOMMENDATIONS

General noise management practices which may be adopted are discussed below. In addition, notification, reporting and complaints handling procedures should be adopted as recommended in section in this report.

6.6.1 Acoustic Barrier

Barriers or screens can be an effective means of reducing noise. Barriers can be located either at the source or receiver.

The placement of barriers at the source is generally only effective for static plant. Equipment which is on the move or working in rough or undulating terrain cannot be effectively attenuated by placing barriers at the source.

Barriers can also be placed between the source and the receiver.

The degree of noise reduction provided by barriers is dependent on the amount by which line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15 dB(A) can be affected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8 dB(A) may be achieved. Where no line of sight is obstructed by the barrier, generally no noise reduction will occur.

As barriers are used to provide shielding and do not act as an enclosure, the material they are constructed from should have a noise reduction performance which is approximately 10dB(A) greater than the maximum reduction provided by the barrier. In this case the use of a material such as 10 or 15mm plywood would be acceptable for the barriers.

6.6.2 Silencing Devices

Where construction process or appliances are noisy, the use of silencing devices may be possible. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

6.6.3 Material Handling

The installation of rubber matting over material handling areas can reduce the sound of impacts due to material being dropped by up to 20dB(A).

6.6.4 Treatment of Specific Equipment

In certain cases, it may be possible to specially treat a piece of equipment to reduce the sound levels emitted. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

6.6.5 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. This includes locating fixed plant items as far as possible from residents as well as rotating plant and equipment to provide respite to receivers.

Construction vehicles accessing the site should not queue in residential streets and should only use the designated construction vehicle routes. Loading of these vehicles should occur as far as possible from any sensitive receiver.

6.7 NOISE MONITORING (IF REQUIRED)

In the event that complaints are made from neighbouring properties regarding noise impacts from the subject site, noise monitors will be installed at the property boundaries of the neighbouring properties nearest to the subject site to monitor noise levels.

6.7.1 Downloading of Noise Monitor Data

Downloading of the noise monitor data will be conducted on a regular basis. In the event of consistent high noise level periods, downloading of the noise monitor data will be conducted more frequently. Results obtained from the noise monitor will be presented in a graph format and will be forwarded to the client for review. It is proposed that reports are provided fortnightly, presenting the measured noise levels in reference to the noise management levels detailed in this report.

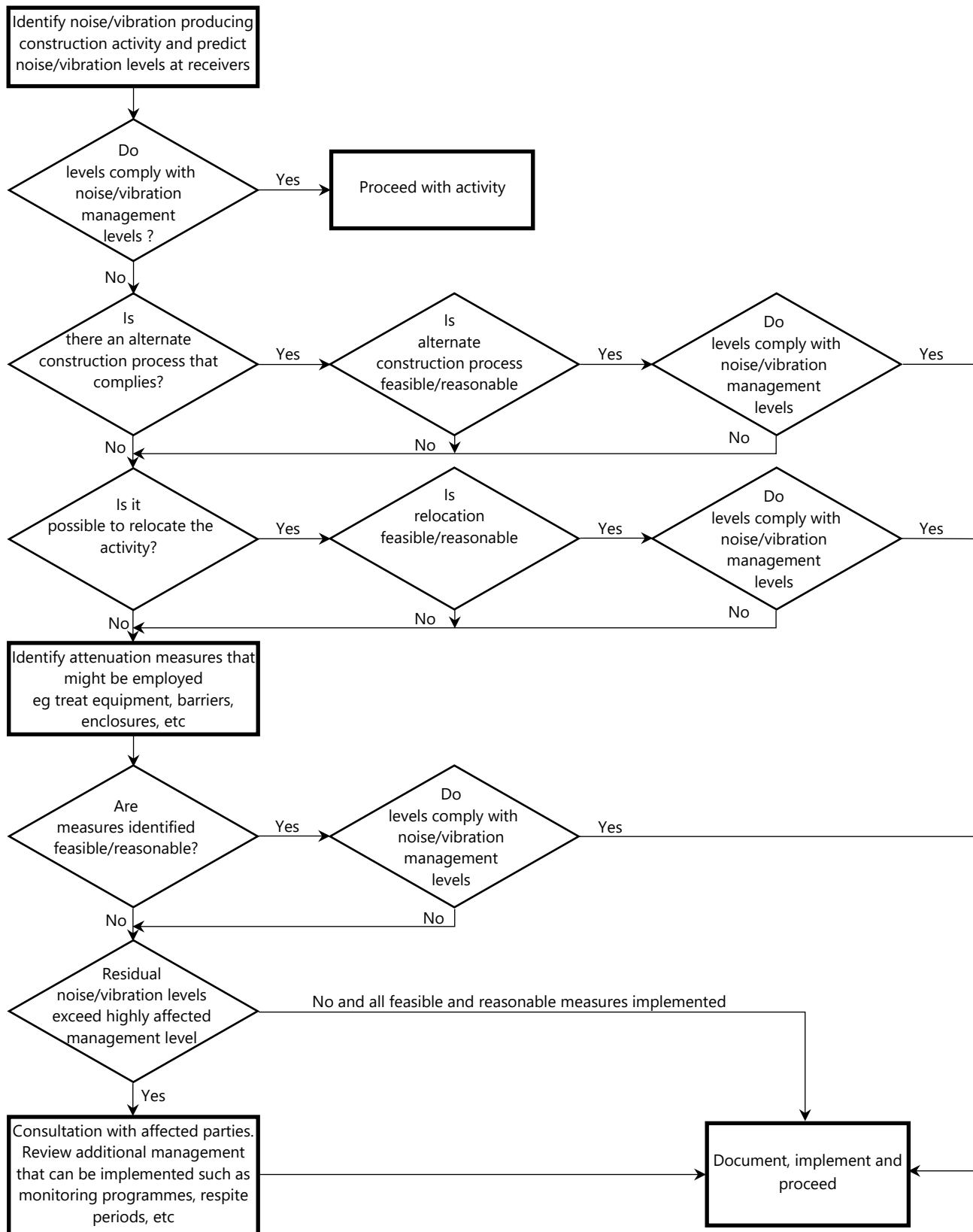
6.7.2 Presentation of Noise Monitor Results

A fortnightly report will be submitted to the client via email summarising the measured noise level events. Complete results of the continuous noise logging will be presented in fortnightly reports including graphs of the collected data.

7 ASSESSMENT METHODOLOGY AND MITIGATION METHODS

The flow chart that follows illustrates the process to be followed to minimise the impact associated with these activities.

Noise sources with the potential to exceed the criteria set out in section 6 have been identified and discussed in section 8.



8 ASSESSMENT OF VIBRATION

8.1 VIBRATION PRODUCING ACTIVITIES

Proposed activities that have the potential to produce significant ground vibration include:

- Demolition Work.
- Excavation Work (Hammering).

8.2 SAFEGUARDS TO PROTECT SENSITIVE STRUCTURES

Typically, demolition/excavation work are the activities with the greatest potential for generation of vibration based on the proposed construction activities to be undertaken at the project site.

The primary potential vibration source will be from hydraulic hammering with adjacent hospital receivers in close proximity. Vibration monitoring will be required during the construction stage of the redevelopment to ensure that vibration levels to surrounding nearest hospital receivers are managed.

8.3 VIBRATION MONITORING

AL recommends that vibration monitoring is undertaken at all sensitive receivers throughout the construction of the project. Any vibration monitor is to have SMS notification capability to enable contractor to be immediately informed when vibration limits are reached.

8.3.1 Downloading of Vibration Monitor Data

Downloading of the vibration monitor data will be conducted on a regular basis. In the event of exceedance of the vibration criteria, downloading of the vibration monitor data will be conducted more frequently. Results obtained from the vibration monitor will be presented in a graph format and will be forwarded to the client for review. It is proposed that reports are provided fortnightly with any exceedances in the vibration criteria reported as detailed in this report.

8.3.2 Presentation of Vibration Monitor Results

A fortnightly report will be submitted to the client via email summarising the vibration events. The vibration exceedance of criteria is recorded, and the report shall be submitted within 24 hours. Complete results of the continuous vibration logging will be presented in fortnight reports including graphs of the collected data.

9 COMMUNITY INTERACTION AND COMPLAINTS HANDLING

9.1 ESTABLISHMENT OF DIRECT COMMUNICATION WITH AFFECTED PARTIES

In order for any construction noise management programme to work effectively, continuous communication is required between; all parties which may be potentially impacted upon, the builder and the regulatory authority. This establishes a dynamic response process which allows for the adjustment of control methods and criteria for the benefit of all parties.

The objective in undertaking a consultation process is to:

- Inform and educate the groups about the project and the noise controls being implemented.
- Increase understanding of all acoustic issues related to the project and options available.
- Identify group concerns generated by the project, so that they can be addressed.
- Ensure that concerned individuals or groups are aware of and have access to the Site Complaints Register which will be used to address any construction noise related problems should they arise.

To ensure that this process is effective, regular scheduled meetings may be required for a finite period, until all issues have been addressed and the evidence of successful implementation is embraced by all parties.

An additional step in this process is to produce a newsletter informing nearby residents of upcoming activities that are likely to generate higher noise/vibration levels.

9.2 DEALING WITH COMPLAINTS

Should ongoing complaints of excessive noise or vibration occur, immediate measures shall be undertaken to investigate the complaint, the cause of the exceedances and identify the required changes to work practices. In the case of exceedances of the vibration limits, all work potentially producing vibration shall cease until the exceedance is investigated. The effectiveness of any changes shall be verified before continuing. Documentation and training of site staff shall occur to ensure the practices that produced the exceedances are not repeated.

If a noise complaint is received the complaint should be recorded on a Noise Complaint Form. The complaint form should list:

- The name and address of the complainant (if provided).
- The time and date the complaint was received.
- The nature of the complaint and the time and date the noise was heard.
- The name of the employee who received the complaint.
- Actions taken to investigate the complaint, and a summary of the results of the investigation.
- Required remedial action, if required.
- Validation of the remedial action.
- If necessary, setup vibration monitoring at the location representing the nearest affected vibration receiver, with alarm device which can inform the project manager on site if the vibration exceedance happened.
- Summary of feedback to the complainant.

A permanent register of complaints should be held.

All complaints received should be fully investigated and reported to management. The complainant should also be notified of the results and actions arising from the investigation.

The investigation of a complaint shall involve where applicable.

- noise measurements at the affected receiver.
- an investigation of the activities occurring at the time of the incident.
- inspection of the activity to determine whether any undue noise is being emitted by equipment; and
- Whether work practices were being carried out either within established guidelines or outside these guidelines.

Where an item of plant is found to be emitting excessive noise, the cause is to be rectified as soon as possible. Where work practices within established guidelines are found to result in excessive noise being generated then the guidelines should be modified so as to reduce noise emissions to acceptable levels. Where guidelines are not being followed, the additional training and counselling of employees should be carried out.

Measurement or other methods shall validate the results of any corrective actions arising from a complaint where applicable.

10 CONTINGENCY PLANS

Where non-compliances or noise complaints are raised the following methodology will be implemented.

1. Determine the offending plant/equipment/process.
2. Locate the plant/equipment/process further away from the affected receiver(s) if possible.
3. Implement additional acoustic treatment in the form of localised barriers, silencers etc where practical.
4. Selecting alternative equipment/processes where practical.
5. If necessary, setup noise and vibration monitoring devices at locations representing the nearest noise/vibration and dust affected receivers and provide data for each complain time period. Analysis is required to determine suitable mitigation measures.

Complaints associated with noise and vibration generated by site activities shall be recorded on a Complaint Form. The person(s) responsible for complaint handling and contact details for receiving of complaints shall be established on site prior to construction works commencing. A sign shall be displayed at the site indicating the Site Manager to the general public and their contact telephone number.

11 CONCLUSION

This report presents a noise and vibration management plan for the construction activities proposed for the stage 3 redevelopment of Muswellbrook Hospital.

Provided that the practices and recommendations in this report are implemented, the noise and vibration impact during the construction stage will be minimised.

We trust this information is satisfactory. Please contact us should you have any further queries.

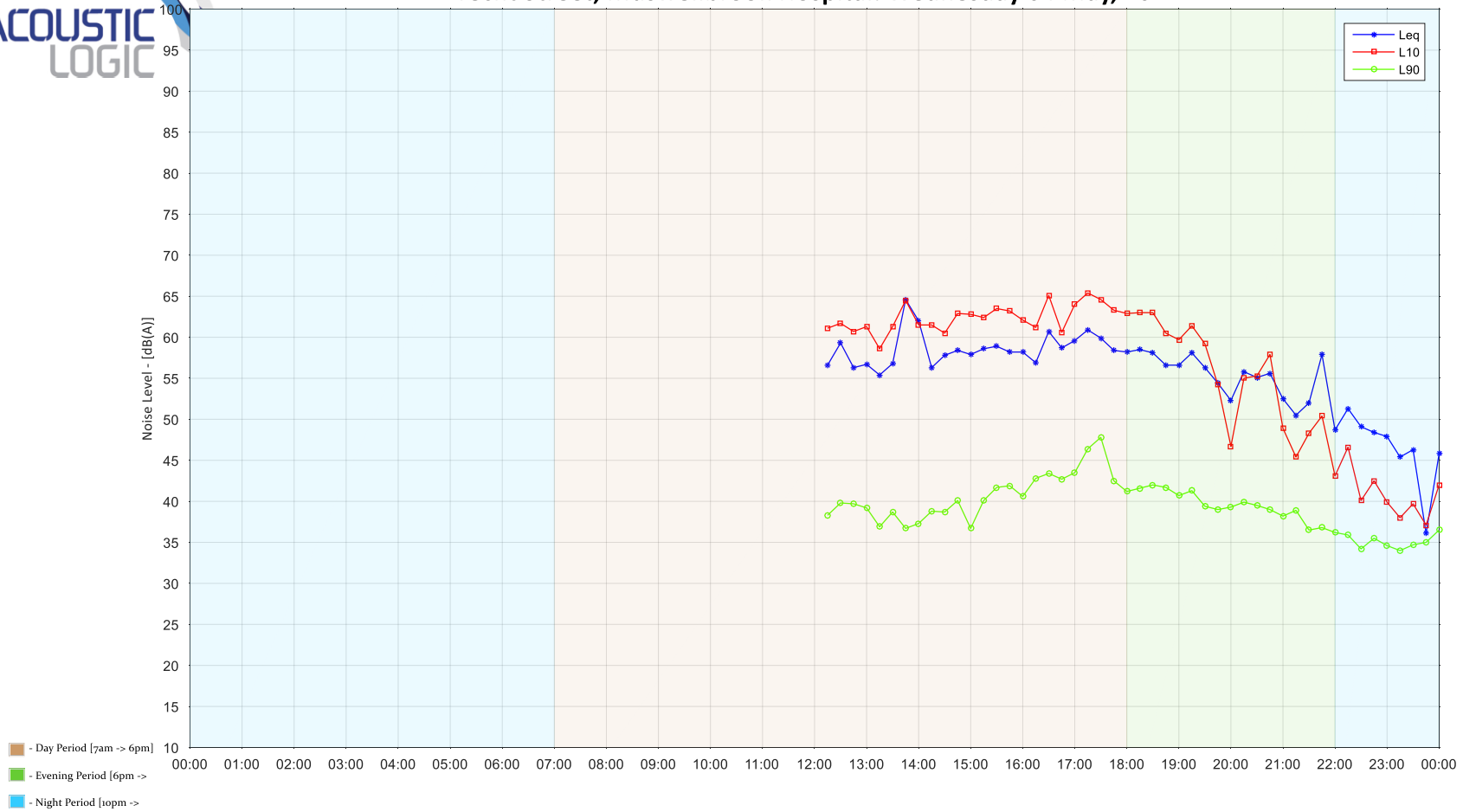
Yours faithfully,

A handwritten signature in black ink, appearing to read 'S. Nichols'.

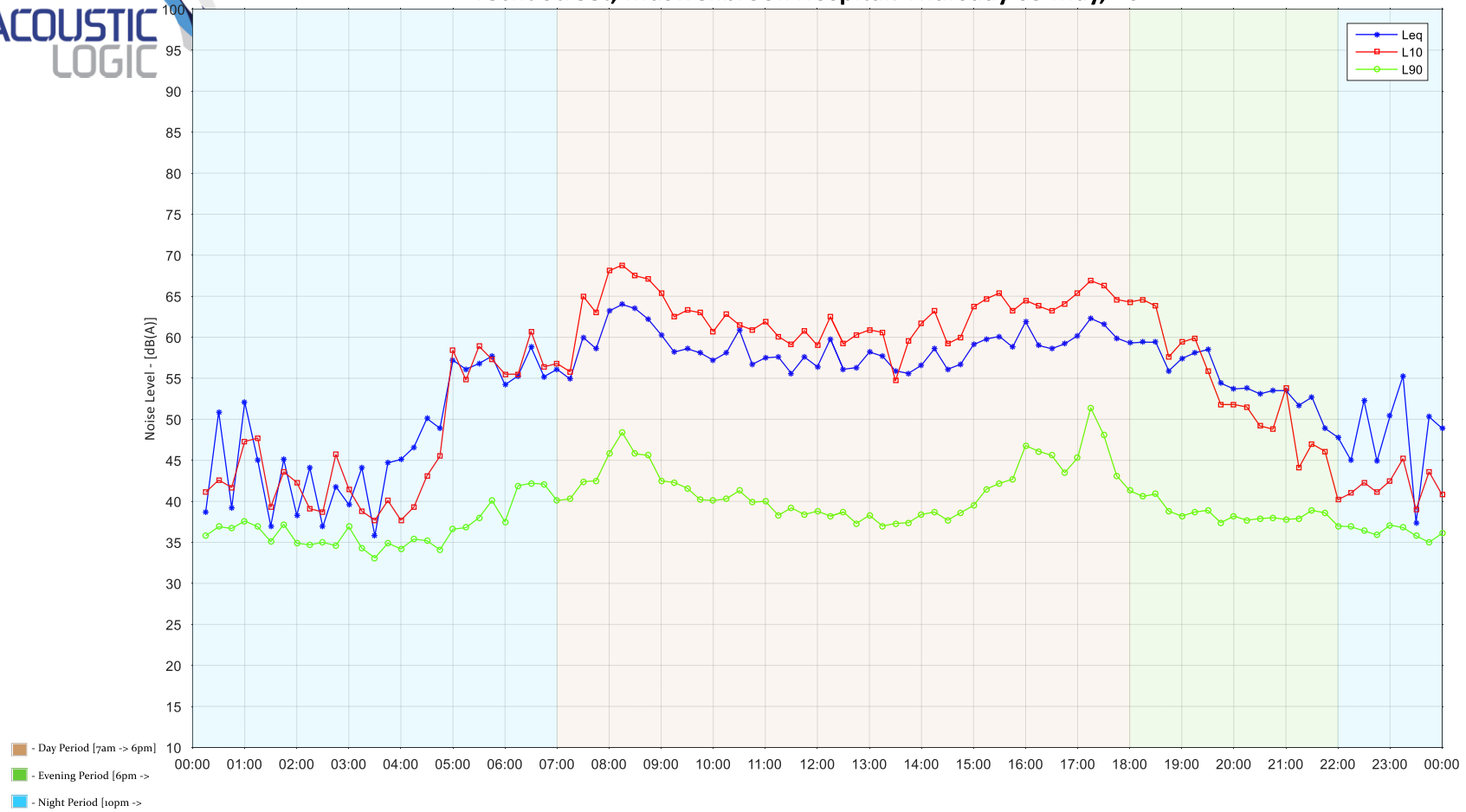
Acoustic Logic Pty Ltd
Shane Nichols

APPENDIX 1 – UNATTENDED NOISE MONITORING DATA

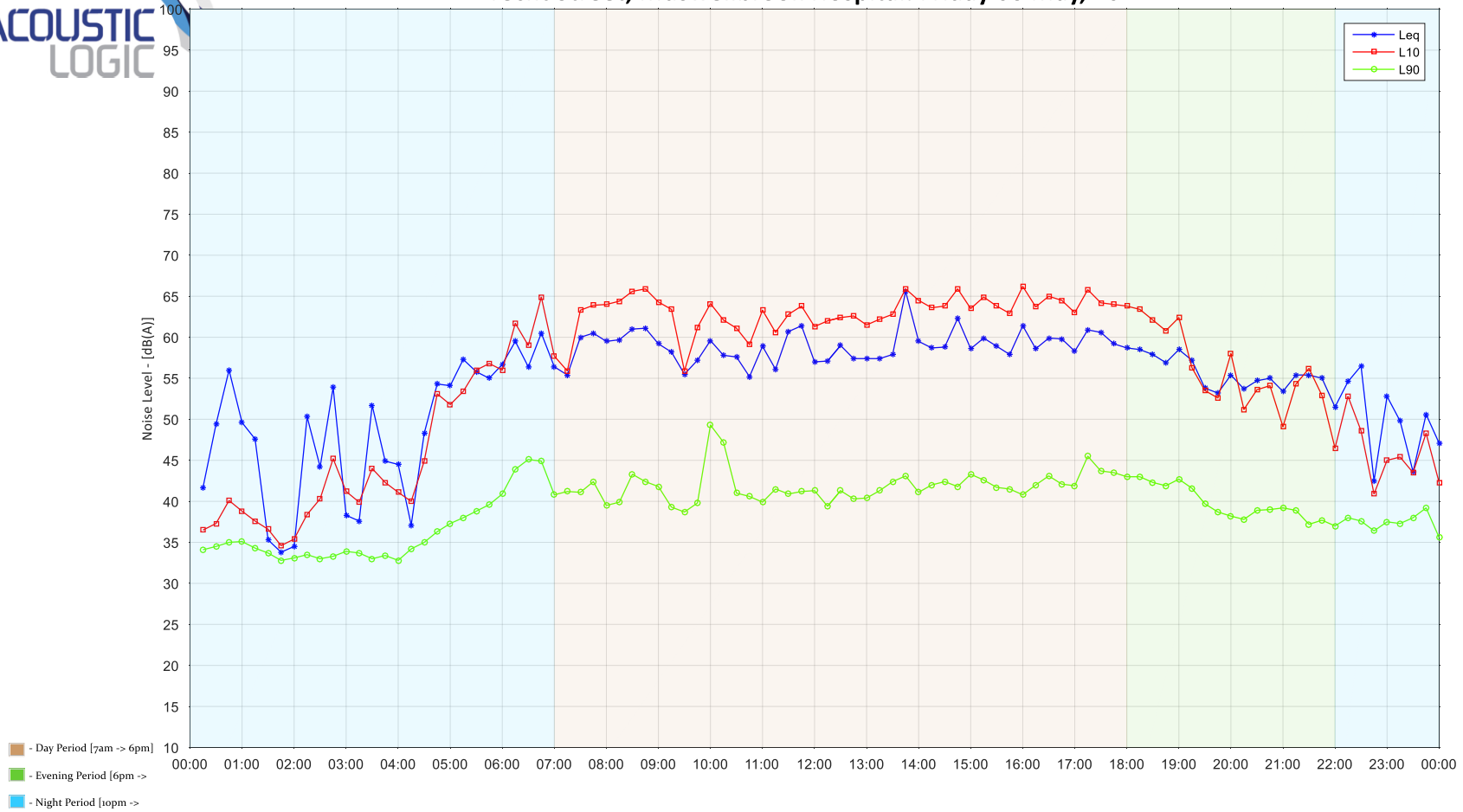
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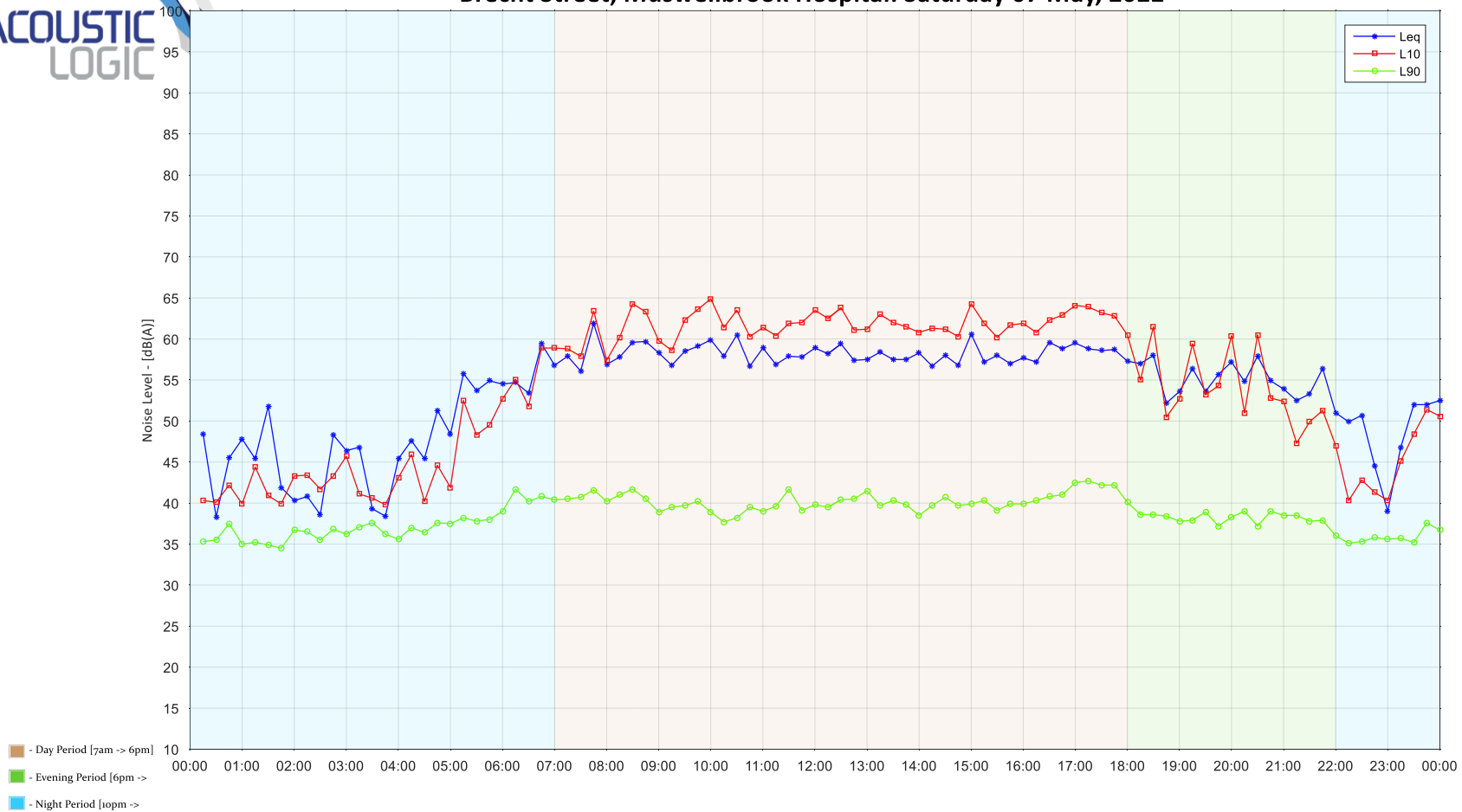
Brecht Street, Muswellbrook Hospital: Thursday 05 May, 2022



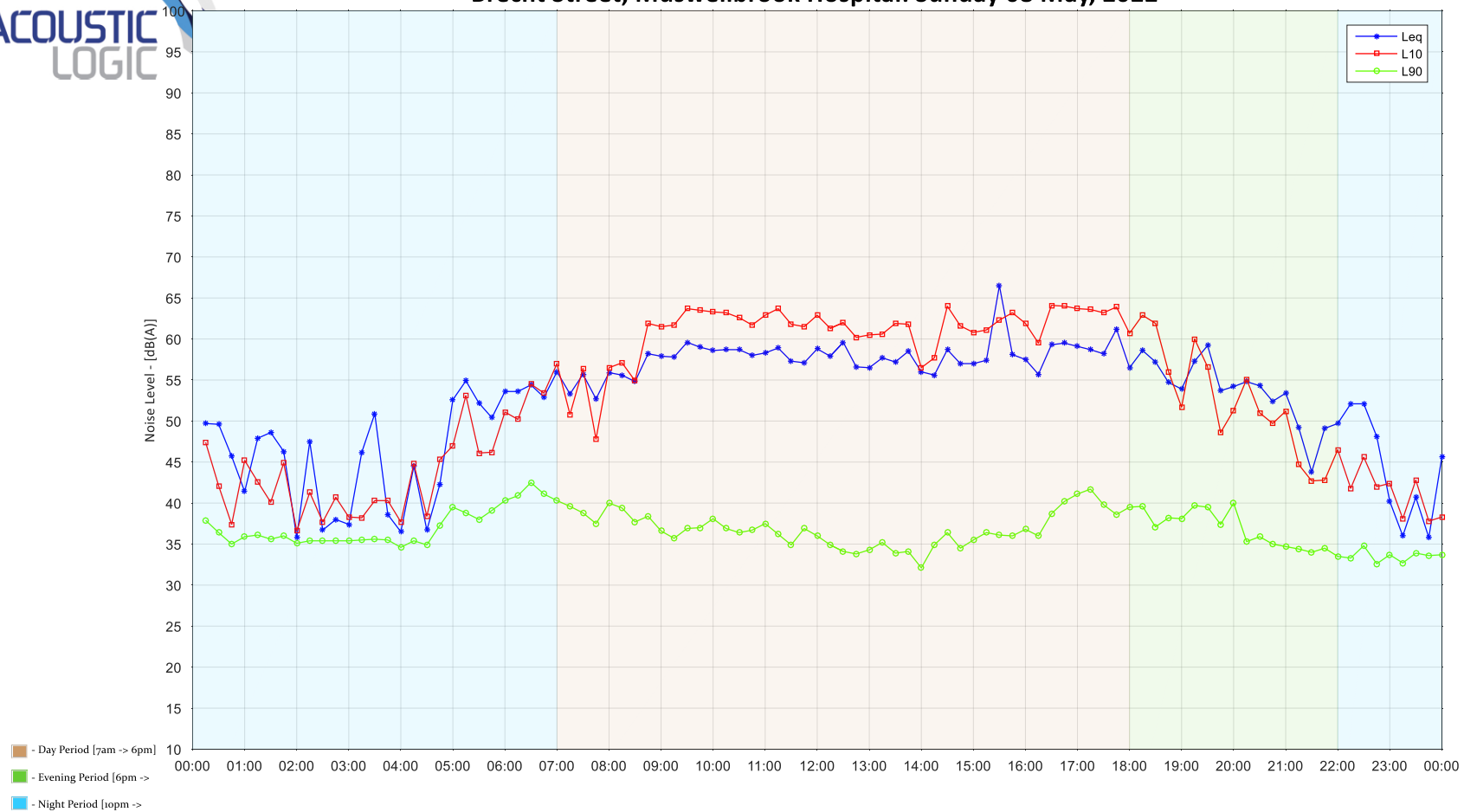
Brecht Street, Muswellbrook Hospital: Friday 06 May, 2022



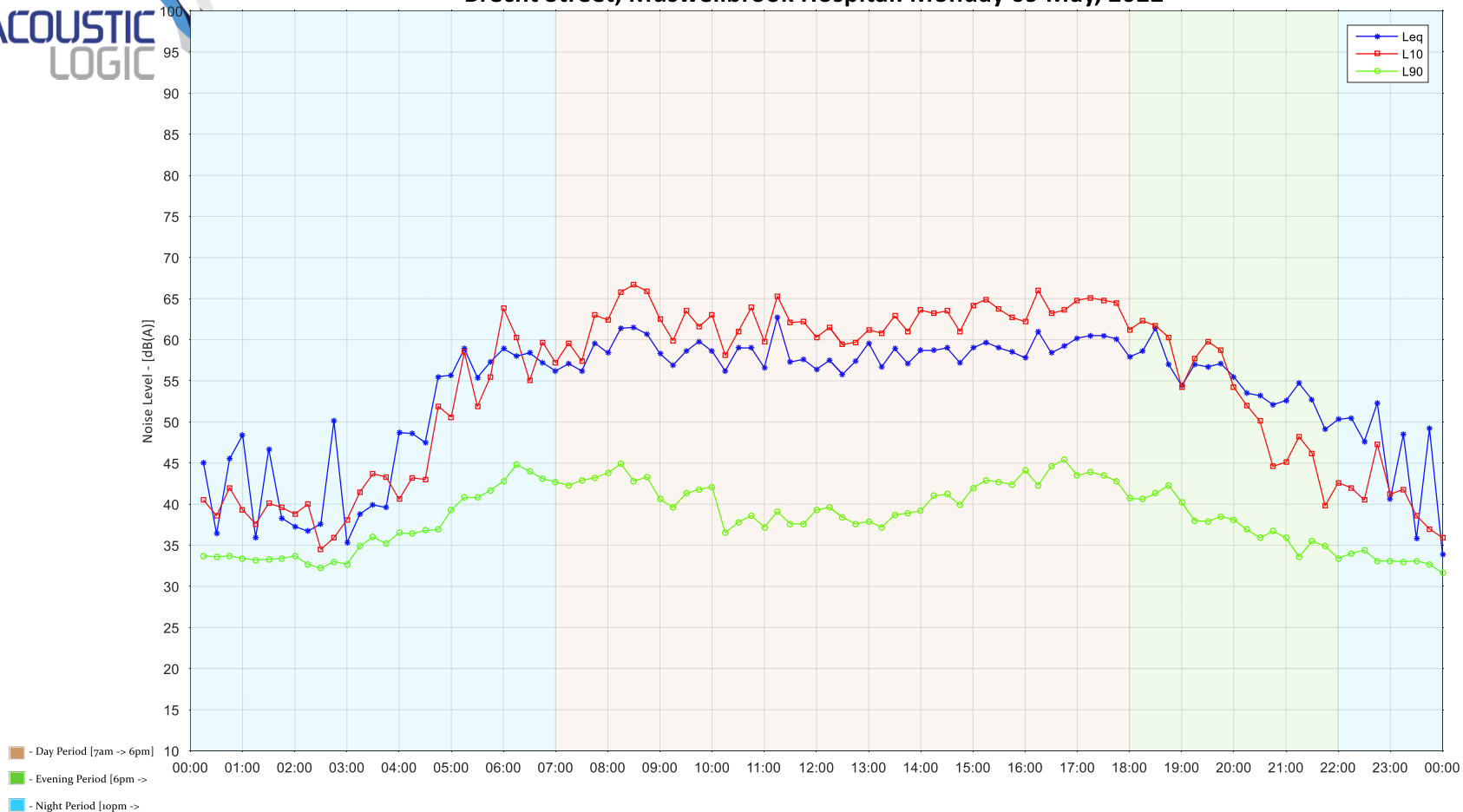
Brecht Street, Muswellbrook Hospital: Saturday 07 May, 2022



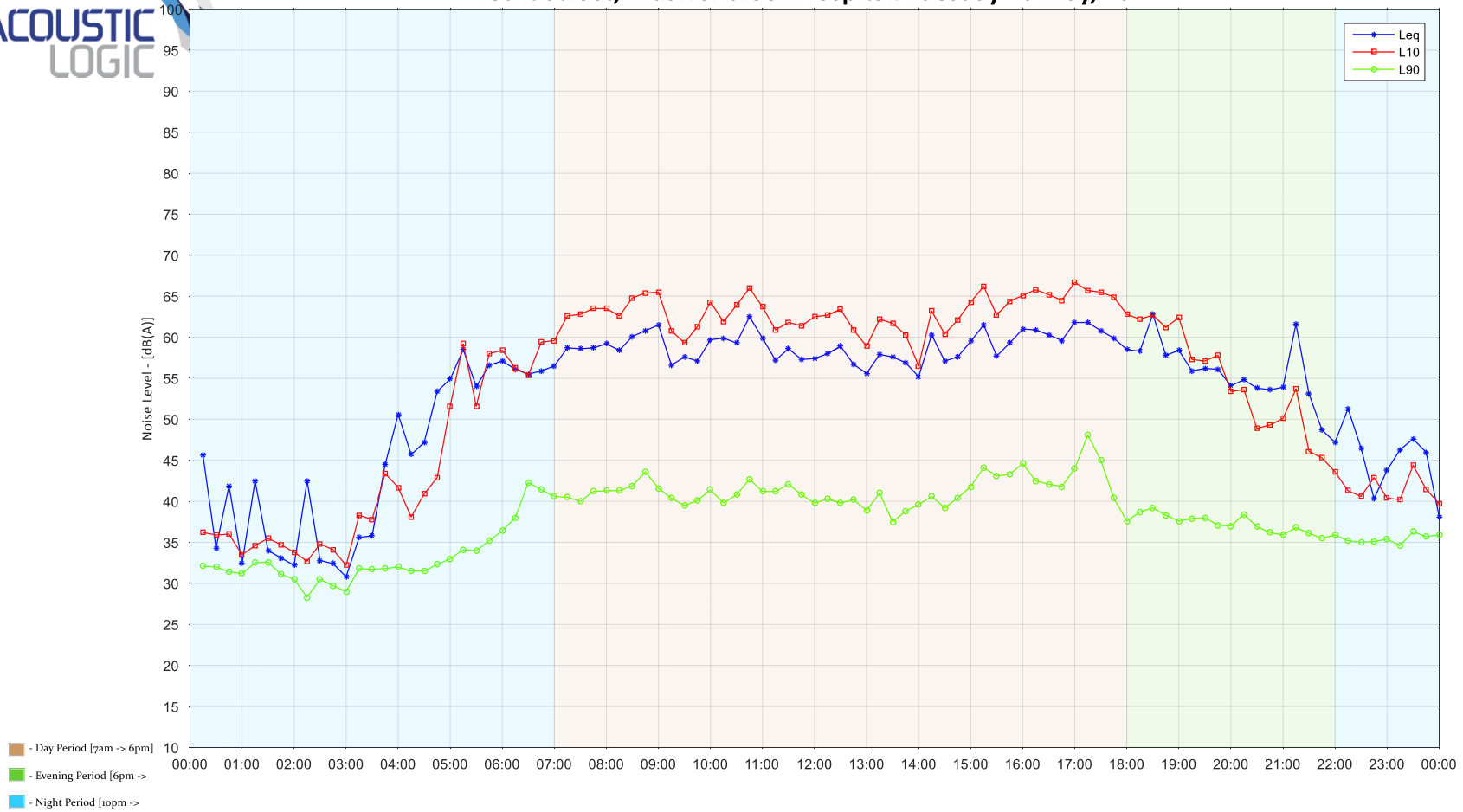
Brecht Street, Muswellbrook Hospital: Sunday 08 May, 2022



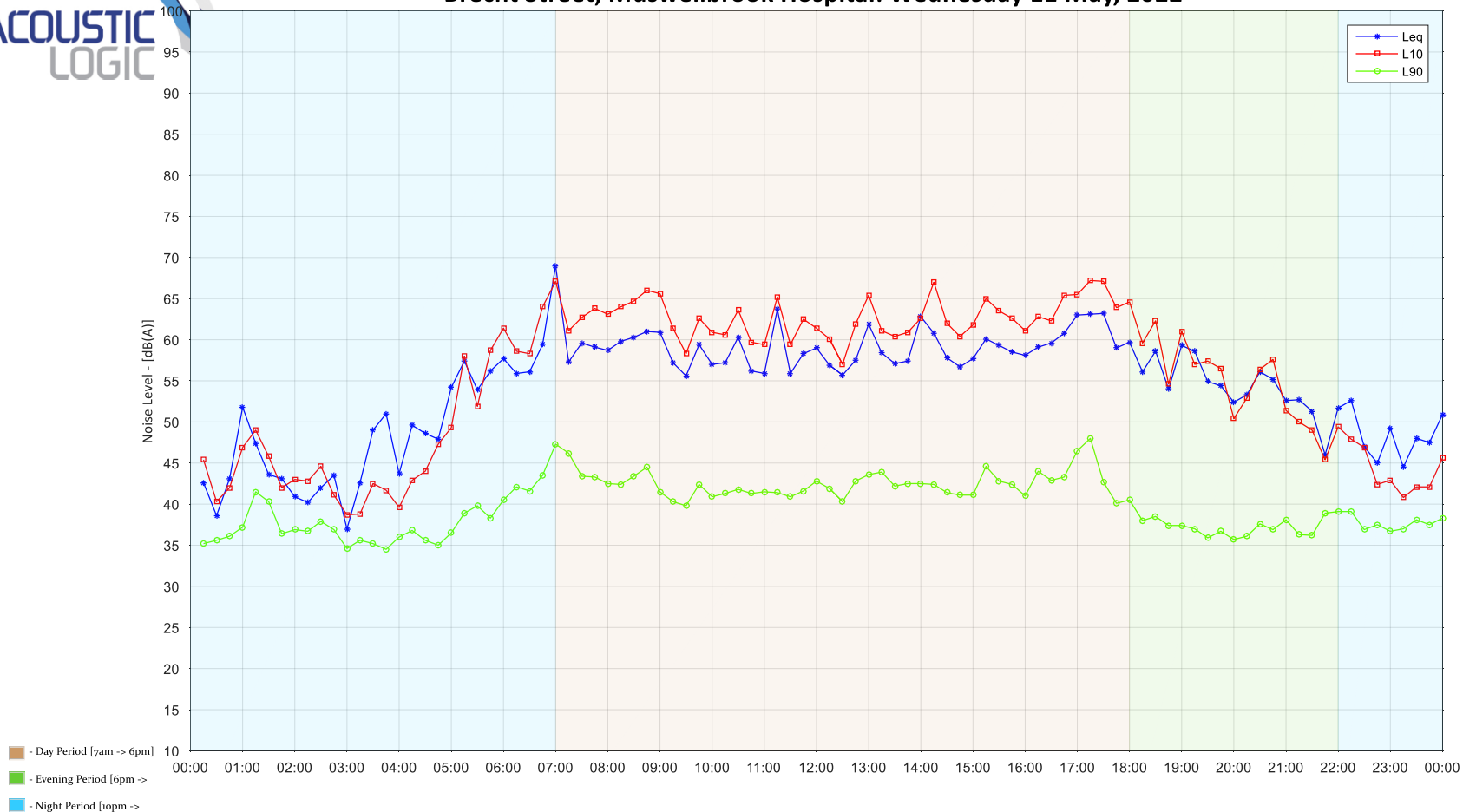
Brecht Street, Muswellbrook Hospital: Monday 09 May, 2022



Brecht Street, Muswellbrook Hospital: Tuesday 10 May, 2022



Brecht Street, Muswellbrook Hospital: Wednesday 11 May, 2022



Brecht Street, Muswellbrook Hospital: Thursday 12 May, 2022

