

Noise survey & plant noise impact assessment. Spire Hospital, Dunedin.

1. Introduction.

This document provides a summary of the noise survey undertaken at the Spire Hospital, Dunedin to assess the existing MRI plant. It is understood that this plant has been operating under temporary planning consent but has resulted in complaints at the nearby sensitive receptor (ie, the adjacent dwelling to the Spire site).

The results of the noise survey indicate that an adverse impact would be expected at the dwelling based on the existing configuration. Outline mitigation measures are therefore proposed to control the level of noise emissions to a level which is expected to have a low impact. These include the following:

- Relocation of the existing condensers to the rear of the MRI building and construction of solid screening to limit noise emissions to the surroundings.
- Replacement of the existing condensers in a different location to the rear of the MRI building.
- Installation of proprietary attenuation packages. This has not been assessed in detail as this is not expected to be practical or cost effective.

2. Acoustic survey.

2.1 Methodology.

A series of acoustic survey measurements have been undertaken at the site to quantify the prevailing noise climate in the area. Locations of the acoustic survey measurements are shown on the figure below.

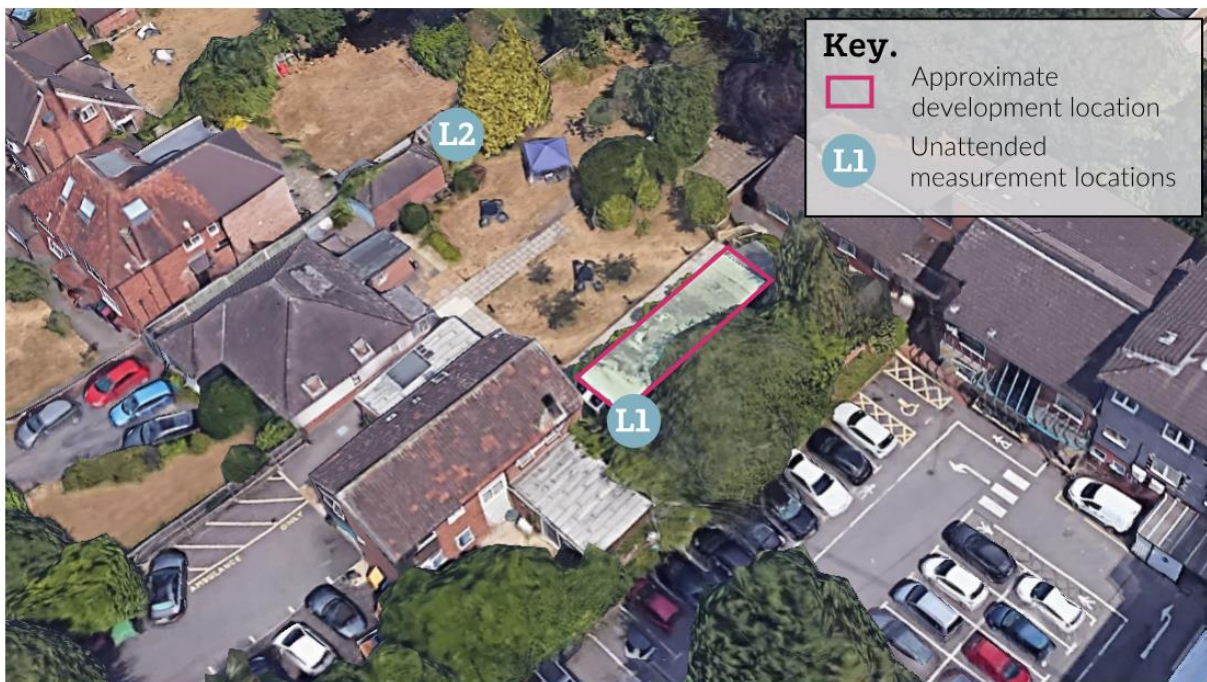


Figure 1 Acoustic survey locations.

The acoustic survey included unattended survey measurements at two locations from Friday 29 November to Wednesday 04 December 2019.

Position 1 was chosen as a location representative of the current MRI condensers. Measurements here were made at 1.4m from the ground level with clear line of sight to the condensers.

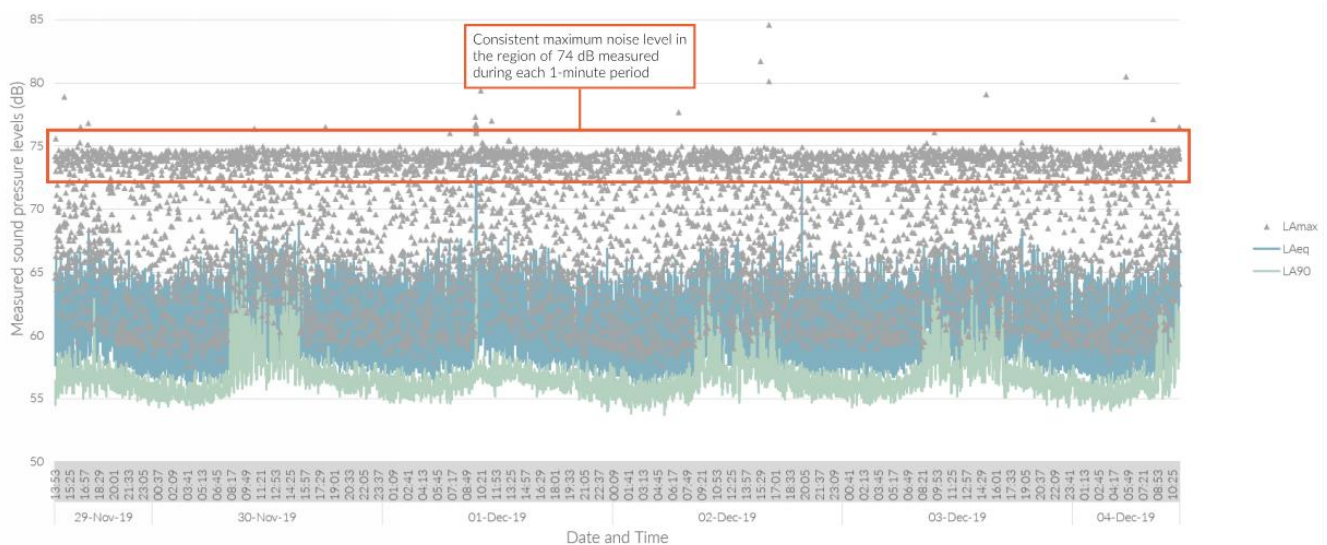
Position 2 was chosen as a location representative of the rear elevations of the nearest sensitive receptors on Downshire Square. Measurements were made at 1.4m from the ground level with the microphone under free-field conditions.

All survey equipment was field calibrated at the start and end of each set of measurements with no discernible drift in level observed.

2.2 MRI condenser noise - Position L1.

During the site visits, the MRI condensers were observed to be operating intermittently for short time periods (ie, running for a few seconds at a time). While the condensers were operating, this was found to drive the noise levels in the local vicinity.

From the measured survey data, the intermittent operation appears to have been consistent throughout the survey period, including during the night time. The maximum noise levels during each 1-minute period were consistently found to be in the region of 74 dB. This is indicated in the below time history chart for the data obtained at measurement position 1.



Audible noise was also noted to be breaking out of the MRI enclosure itself. During the site visits, the noise levels were considerably lower than the condenser units and are assumed not to be the cause of the complaints which are understood to have arisen. However, any other known problematic noise sources other than the condensers would need to be confirmed.

2.3 Nearby sensitive receptor - Position L2.

The ambient noise levels measured at the boundary of the worst affected nearby sensitive premises (ie, position L2) are summarised in Table 1.

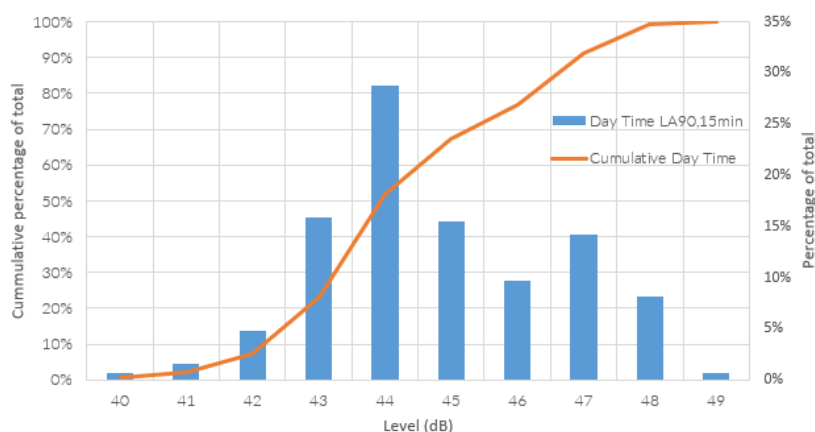
Table 1 Ambient noise levels measured near sensitive receptors on Downshire Square (position 2)

Date	Daytime (07:00 – 23:00) L _{Aeq,16 h} , dB	Night-time (23:00 – 07:00) L _{Aeq,8 h} , dB
Friday 29th November 2019	48*	45
Saturday 30th November 2019	50	47
Sunday 01st December 2019	49	43
Monday 02nd December 2019	49	44
Tuesday 03rd December 2019	49	45
Wednesday 04th December 2019	49*	-

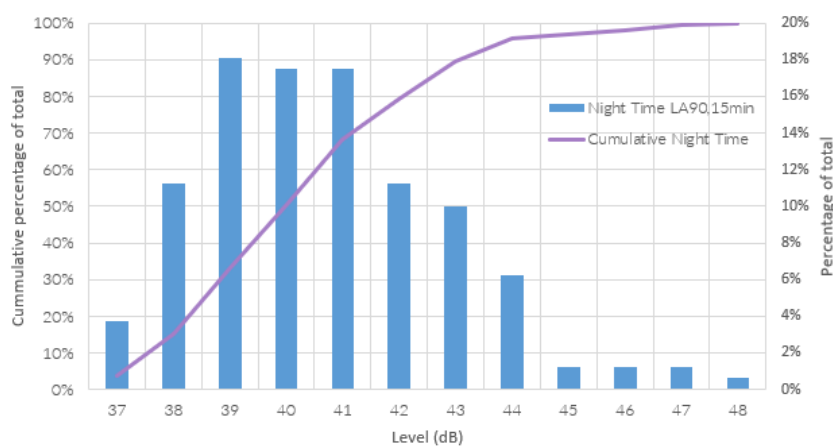
* Does not include full 16 h period.

In line with BS 4142:2014 (discussed in Section 3), for the purpose of analysis and establishing representative background noise levels during the periods of interest, the background noise levels have been quantified using statistical analysis from the continuous logging measurements. These are presented below.

Day (16hr) LA90,15min at Position L2



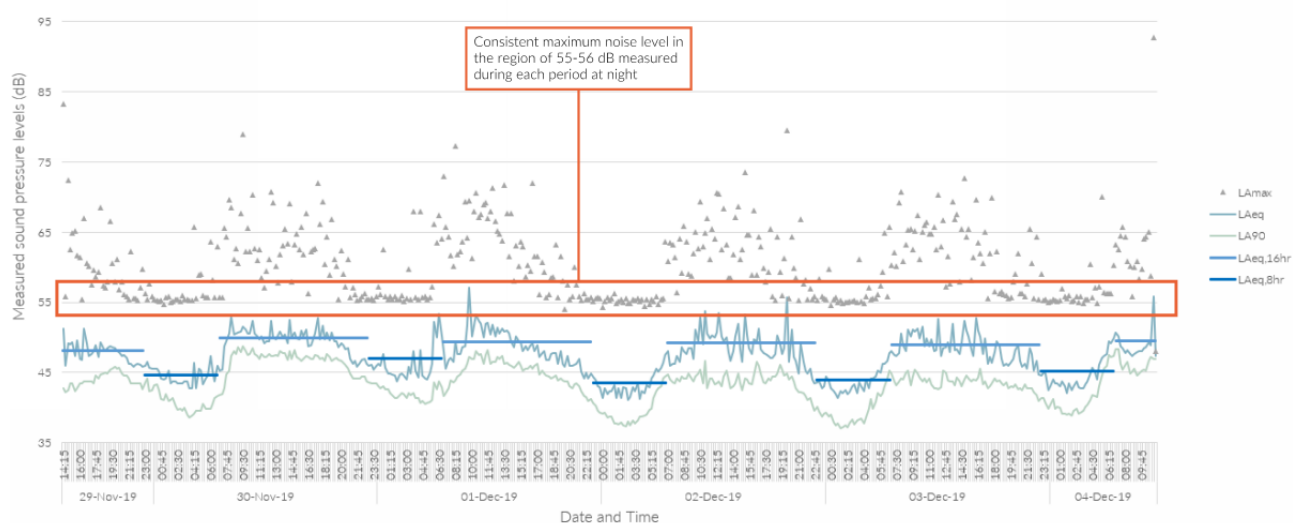
Night LA90,15min at Position L2



Although the condensers were operating during the measurement period, the intermittent nature means that the background noise levels (ie, the noise level exceeded 90% of the time) are not considered to be affected by the condenser noise. These levels are therefore considered to be representative of the noise climate at the nearby sensitive premises without the condensers operating.

From the analysis carried out, the representative background noise levels measured during the survey were respectively $L_{A90,15min}$ 43 dB during the daytime period, and $L_{A90,15min}$ 38 dB during the night-time period. These levels are based on the 20th percentile of measured background noise levels.

It is worth noting that the condensers were audible at the measurement position during the times that they were operating. The time history graph shown below indicates that the maximum noise levels (L_{Amax}) measured during the night time was generally driven by the condenser noise with a resultant level in the region of L_{Amax} 55-56 dB.



3. Plant noise emission criteria.

Noise emissions from any plant/machinery associated with new developments would typically be assessed in accordance with the guidance given in BS 4142:2014 'Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas'.

This sets out a method for assessing the level of plant noise (ie, the rating level) at a sensitive location compared to the existing background noise level without the plant operating. Where the rating level exceeds the background, the level of impact increases as shown below in Table 2.

Table 2 BS4142 assessment criteria

Comparison with background	Assessment
+0 dB or below measured background	Low impact
+ 5 dB	Adverse impact
+ 10 dB or more above measured background	Significant adverse impact

To ensure a 'low impact' in line with BS 4142, it is recommended that mitigation measures be designed to ensure that the noise emissions from the MRI condensers do not exceed the existing background noise levels measured at position L2. These limits are summarised in Table 3.

Table 3 Proposed plant noise emission limits

Time of day	Maximum sound pressure level at 1m from the nearest noise sensitive premises ($L_{Aeq,15min}$, dB)
07:00 to 23:00 hours	42
23:00 to 07:00 hours	35

It should be noted that a further correction should be applied to the above limits if the plant noise contains any attention catching features (ie, tonal, impulsive or intermittent) in line with BS 4142. These corrections are as follows:

Tonality:

- -2dB for a tone which is *just* perceptible
- -4dB for a tone which is *clearly* perceptible
- -6dB for a tone which is *highly* perceptible

Impulsivity:

- -3dB for impulsivity which is *just* perceptible
- -6dB for impulsivity which is *clearly* perceptible
- -9dB for impulsivity which is *highly* perceptible

Intermittency:

- -3 dB for intermittency which is readily distinctive against the residual acoustic environment.

4. Assessment.

4.1 Existing conditions.

The existing maximum noise levels from the condensers at the boundary of the nearby sensitive premises were found to be up to up to L_{Amax} 56 dB. Given the extent that this exceeds the noise limits given above, this is a good indication of adverse impact on the nearby dwelling.

4.2 Outline mitigation options.

To reduce the noise emissions in line with the proposed criteria, possible mitigation options are set out in Table 4.

Table 4 Mitigation options

Option	Recommendations
Relocate existing condensers (shown indicatively in Figure 2)	- Relocate the condensers so that the MRI building provides screening to the nearby sensitive receptor. This assumes that the condensers can be positioned within approximately 1 m of ground level so that MRI building provides adequate screening. - Construct solid screening around the condensers to ensure that noise emissions do not have an adverse impact on other residential premises (eg, across Downshire Square from the Spire site). The screening should provide a minimum surface density of 15 kg/m² (eg, marine plywood with an overall depth of 26 mm) and extend to around 1 m above the top of the condensers (subject to the specific condenser configuration). In addition, it is recommended that a 50-100 mm sound absorbent material be provided to the internal face of the screening. - This approach does not consider the impact of noise on the nearby Spire buildings.

Option	Recommendations
Replace condensers	If it is more practicable to replace the condensers rather than reuse the existing units, the following is recommended: – Install the condensers in the relocated location as set out above – Select new units which do not exceed a level of 65 dBA at 1 m (assuming no more than 2 units). – Based on this, the solid screening would not be required to control noise emissions to the other nearby sensitive premises (however this again does not consider the impact of noise on the nearby Spire buildings and car park / external public areas)
Provide attenuation packages	A further option would be to provide proprietary attenuation packages to the existing condensers, however this be expected to be costly and not practical given the condenser locations. If this option would be preferable, further comments can be provided.



Figure 2 Recommended relocation of plant