



HINCKLEY HOSPITAL

PLANT NOISE ASSESSMENT FOR NEW ENDOSCOPY AND CDC WING

Acoustics Report A1996 R01A

July 2023

Report to:

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Contents

1	Introduction	1
2	Scheme Details.....	1
3	Planning Guidance	2
3.1	National Planning Policy Framework (NPPF).....	2
3.2	Noise Policy Statement for England (NPSE)	2
3.3	Online Planning Practice Guidance	3
3.4	BS 4142:2014.....	4
4	Noise Survey	5
4.1	Survey Methodology	5
4.2	Survey Results.....	6
5	Noise Targets	7
5.1	Emergency Generator	8
6	Preliminary Plant Noise Calculations	8
6.1	External Plant.....	8
6.2	Calculations.....	9
6.3	Mitigation.....	9
6.4	Context and Uncertainty.....	9
6.5	Results.....	10
6.6	Standby Diesel Generator.....	10
7	Conclusions	10

Appendix A – Tabulated Noise Data

Appendix B – Plant Noise Calculations

1 Introduction

Ion Acoustics is appointed by NHS Property Services to provide a noise assessment for new external mechanical services plant proposed for a new Endoscopy & CDC unit at Hinckley Hospital.

This report documents a baseline noise survey carried out on site to quantify the existing background noise levels at a location representative of nearby noise sensitive receptors. These are houses opposite the development on Mount Road. The survey results have been used to set plant noise limits. Preliminary calculations have been carried out to check that typical external plant selections can meet the limits. This report can be submitted with the planning application for the Endoscopy and CDC building to demonstrate that residential amenity can be protected.

2 Scheme Details

The scheme involves demolishing the existing portacabin building and constructing a new 2-3 storey building with consulting rooms and various treatment rooms.

New plant will be provided on sections of the roof and within internal plant rooms. An emergency generator will also be required; this will be sited away from the residential locations as far as is practical. The site and the proposed location of the external services plant is shown in Figure 1.

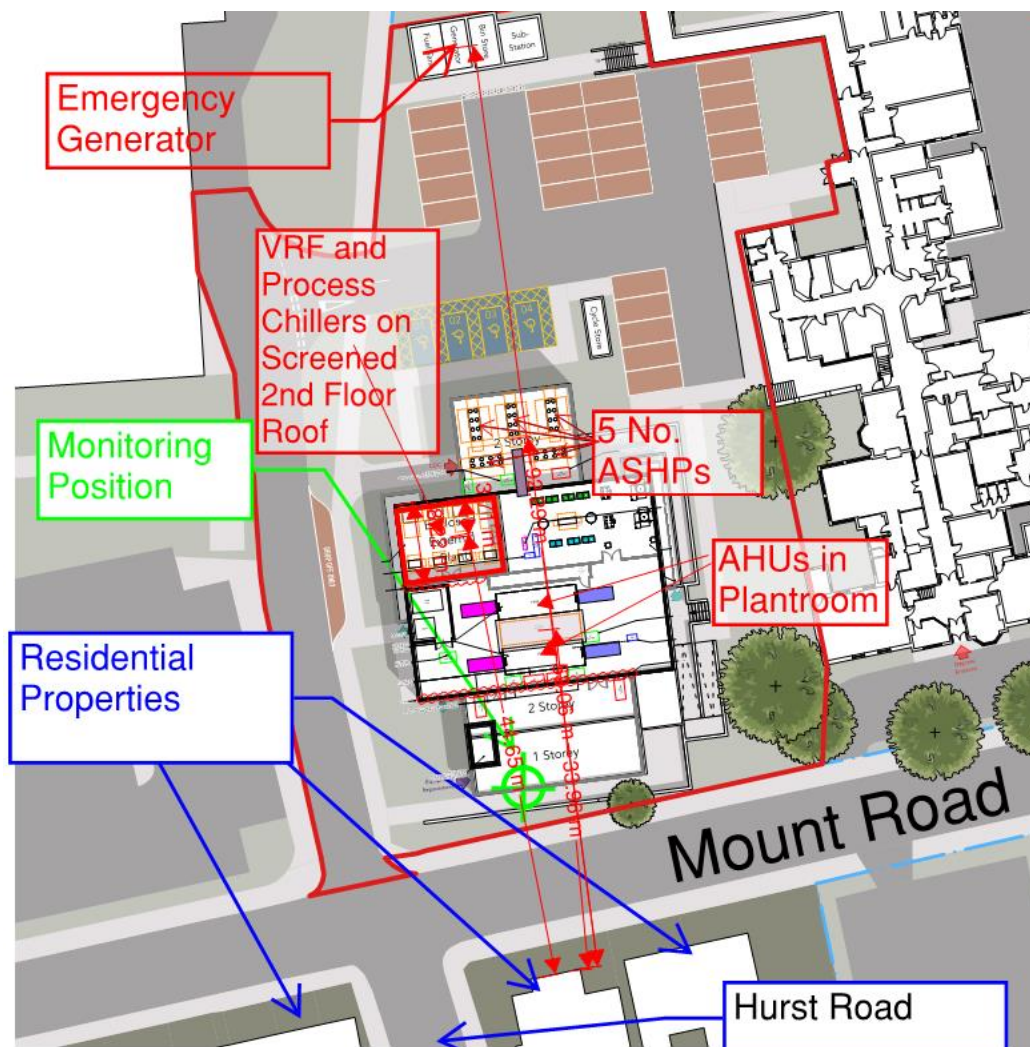


Figure 1 – Site Layout showing the monitoring position and residential properties

3 Planning Guidance

3.1 National Planning Policy Framework (NPPF)

In 2012 the National Planning Policy Framework (NPPF) replaced several Planning Policy Statements with a single document to promote sustainable development. The NPPF was revised in July 2021¹, and specific aspects of the guidance changed.

The NPPF sets out the Government's planning policies for England. The document is generally not prescriptive and does not provide noise criteria. Instead, it places the onus on local authorities to develop local plans and policies. Sections of the NPPF relating to noise are stated below:

174. Planning policies and decisions should contribute to and enhance the natural and local environment by: ...

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution....

185. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; ..."

3.2 Noise Policy Statement for England (NPSE)

The Noise Policy Statement for England (NPSE)² sets out the 'Government's policy on environmental, neighbourhood and neighbour noise for England. The policy has three aims:

- *"avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life, and*
- *where possible, contribute to the improvement of health and quality of life.*

The NPSE introduces the following terms, which are also used in the NPPF:

"NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur".

¹ <https://www.gov.uk/government/publications/national-planning-policy-framework--2>

² Noise Policy Statement for England:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69533/pb13750-noise-policy.pdf

However, neither the NPSE nor the NPPF Planning Practice Guidance defines numeric bounds for NOEL, LOAEL or SOAEL. The boundary of each effect level should be defined for each situation and location.

3.3 Online Planning Practice Guidance

Further Government planning advice is available online³. The online noise section "*advises on how planning can manage potential noise impacts in new development*" and refers to the adverse effect levels set out in the NPSE. It states:

Plan-making and decision making need to take account of the acoustic environment and in doing so consider:

- *whether or not a significant adverse effect is occurring or likely to occur;*
- *whether or not an adverse effect is occurring or likely to occur; and*
- *whether or not a good standard of amenity can be achieved.*

...this would include identifying whether the overall effect of the noise exposure (including the impact during the construction phase wherever applicable) is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation.

The guidance also presents a noise exposure hierarchy table to provide further information on the boundaries between the NOEL, LOAEL and SOAEL. The hierarchy table is shown below in Table 1.

Table 1: Noise Exposure Hierarchy Table

Perception	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not noticeable	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude, or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum

³ See <https://www.gov.uk/guidance/noise--2>

Perception	Examples of Outcomes	Increasing Effect Level	Action
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g., avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

3.4 BS 4142:2014

The standard method for assessing new plant noise affecting housing, is British Standard BS 4142⁴. A BS 4142 assessment is typically made by calculating the difference between the plant noise under consideration and the background sound level as represented by the L_{A90} parameter, determined in the absence of the new plant noise. (Existing plant noise would normally be considered to be part of the background sound level). The L_{A90} parameter is defined as the level exceeded for 90% of the measurement time, representing the underlying noise in the absence of short duration noise events such as dog barks or individual cars passing.

The plant noise under consideration is assessed in terms of the ambient noise level, L_{Aeq} , but a character correction penalty can be applied where the noise exhibits acoustic characteristics such as distinguishable tones, impulsiveness, intermittency or other acoustically significant characteristics. The ambient noise level, L_{Aeq} is defined as the steady-state noise level with the same energy as the actual fluctuating sound over the same time period. It is effectively the average noise level during the period. The new plant noise level (L_{Aeq}) with the character correction (if necessary) is known as rating level, L_{Ar} , and the difference between the background noise and the rating level is determined to make the BS 4142 assessment.

The standard states:

- a) *"Typically, the greater the difference, the greater the magnitude of the impact.*
- b) *A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.*
- c) *A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.*

⁴ BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound, British Standards Institute

d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."

The standard outlines a number of methods for defining appropriate 'character corrections' to determine the rating levels to account for tonal qualities, impulsive qualities, other sound characteristics and/or intermittency.

BS 4142 also stresses the importance of considering the context in which a sound occurs. Factors including the absolute sound level, the character of the sound, the sensitivity of the receptor and the character of the area should be considered when assessing the noise impact.

4 Noise Survey

4.1 Survey Methodology

A baseline noise survey was carried out from 4th to 5th April 2023 with a noise monitor set up on roof of the existing portacabin building as shown below in Figure 2. The location is directly opposite the residential properties on Mount Road and therefore is considered representative of background sound levels at the residential locations.



Figure 2 – Noise Monitoring Location

A Rion NL52 sound level meter was used with Type WS-15 windshield. The microphone and windshield were set up on a tripod to log various noise parameters in 15-minute periods, including the L_{Aeq} , L_{AFmax} , and L_{A90} . The sound level meter was calibration checked at set-up and collection

using a Brüel & Kjær 4231 calibrator. The drift was not significant and was within expected tolerances (<0.1 dB). Both the sound level meter and the calibrator were within their required external calibration intervals. Calibration certificates are available upon request.

The meter was unattended for the duration of the survey except during the set-up and collection, however audio files were recorded at 10-minute intervals in order to identify noise sources. A brief visit to the site was made during the evening at around 9.45pm on 4th April to listen to the noises heard. Low-level plant noise was heard during this period. This was thought to have come from the nearby leisure centre.

The survey was carried out when a forecast indicated suitable weather conditions throughout the entire survey period. At set up and during the evening there were clear skies. However, it is possible a little light drizzle occurred during the morning as the roads were a little damp. The weather conditions would not have unduly affected the results.

During the collection, it was noted that there was some road construction works on Hurst Road with a contra-flow system on this road only. Traffic on Mount Road was unaffected and therefore this is unlikely to have significantly affected the noise climate, particularly the underlying background noise. There was no road construction noise audible. Other than road traffic noise, bird song was noted during the morning.

4.2 Survey Results

The survey results are shown in Figure 3 below in terms of a time history chart showing the L_{Aeq} , L_{A90} and maximum level (dB L_{Amax}) during each 15-minute period. Tabulated data is provided in Appendix A.

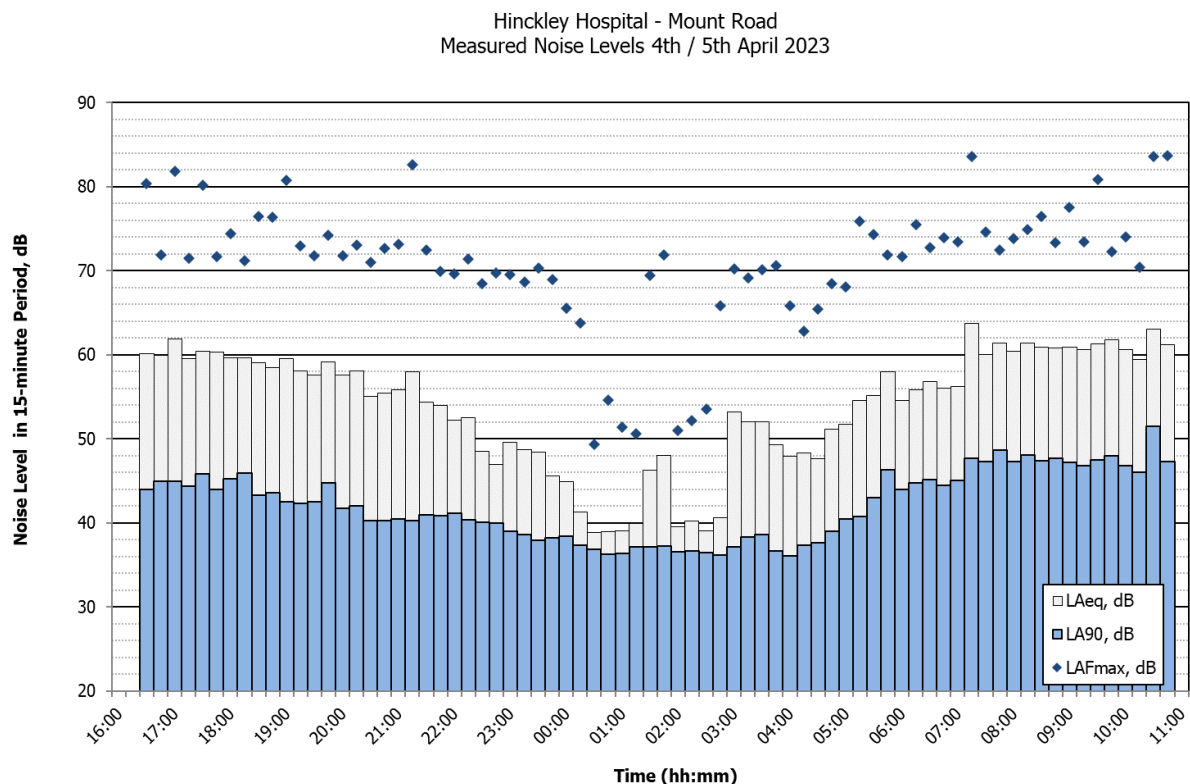


Figure 3 – Time History Chart

The louder event at 07.25 in the morning is thought to have been a waste or recycling lorry or similar.

BS 4142 requires the “typical” background noise level to be determined. To assess this, the survey data has been analysed to obtain the frequency distribution of the integer L_{A90} values as discussed in BS 4142. This is shown in Figure 4 for the daytime, evening and night-time data.

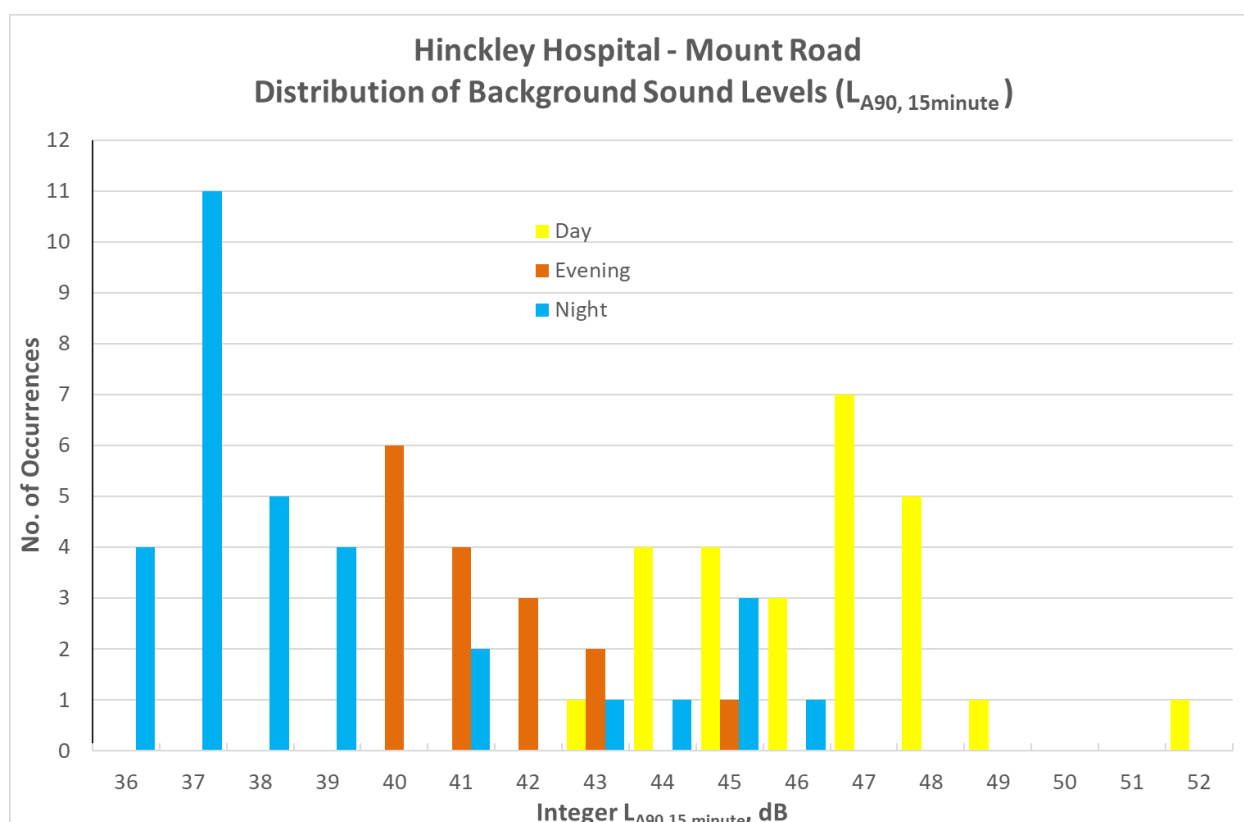


Figure 4 – Histogram of Integer L_{A90} values

Based on Figure 4 above the typical background noise levels can be taken as 40 dB L_{A90} and 37 dB L_{A90} for the evening and night-time respectively. During the daytime, there is a greater spread of noise levels. In this case, to allow for a conservative limit, it is proposed to assume a typical noise level of 45 dB L_{A90} which is lower than the modal (most common value). Approximately 65% of the daytime background noise samples are above this level.

5 Noise Targets

Plant associated with the new building will mainly run during the daytime. However, it is possible that some may run after 7pm and some plant will need to operate at night if there is a demand for cooling. Therefore, noise limits will be set separately for the daytime, evening and night-time.

Although not part of the planning application for the CDC and Endoscopy building, there are subsequent phases of the Hinckley development which, subject to planning permission, could see a further development alongside the Hinckley building. This may also involve mechanical services plant and therefore to account for this, the noise limit for the CDC building has been reduced by 3dB to allow headroom for this. The same limit applied to the new phase 2 building will ensure that the combined overall noise levels do not exceed the typical background noise.

The noise measurements were made in free-field conditions, that is, in the absence of reflections off nearby vertical surfaces. Noise limits for Mount Road would typically be set at a position 1m from any façade. At this location background noise levels would be 3 dB higher due to the façade reflection and therefore 3dB would be added back on to the noise levels so that it applies as a façade reflection and represents levels at 1m. The plant noise calculation would also need to account for the façade reflection.

The noise limits are set out in Table 2 below.

Table 2 Derivation of Noise Limits

Location	Typical Background dB L _{A90}	Reduction to account for Phase 2	Allow for Façade Reflection	Noise Limit dB L _{Ar}
Daytime (07.00 to 19.00 Hours)	45	-3	+3	45
Evening (19.00 to 23.00 Hours)	40	-3	+3	40
Night-time (23.00 to 07.00 Hours)	37	-3	+3	37

The noise limit relates to the BS 4142 rating level (dB L_{Ar}) of the plant including any character corrections. They should apply at 1m from the window of any habitable room of a dwelling. The noise limits will ensure a low impact according to BS 4142. These limits could also apply to the phase 2 building as discussed above.

These limits will ensure that any noise is “present but not intrusive” and therefore the lowest adverse effect level such that noise does not unduly affect the character area or result in a loss of amenity.

5.1 Emergency Generator

The proposed emergency generator will only run in the event of a power cut. However, it would be tested, typically once per month. It is proposed to set a limit 5dB higher than the daytime background noise for the emergency generator. Therefore, from the emergency generator should not exceed 50 dB L_{Ar} at any residential location.

6 Preliminary Plant Noise Calculations

6.1 External Plant

At this stage of the design, final plant selections have not been made. However, indicative plant selections have been made available of typical plant that can meet servicing requirements following discussions with Hoare Lea Mechanical Services Engineers. These are set out below.:

- 5 No. Air Source Heat Pump (ASHPs) located on the 2nd floor flat roof at the rear (north side) – away from Mount Road – Typical Sound Power of each unit 80 dB L_{WA}
- Process chillers for cooling specialist equipment such as the MRI scanner. These will probably be procured separately as part of a specialist package so details are unknown. To be located on second floor roof with acoustic screens to the west. Sound levels unknown.

- A number (unknown) of VRF Condensers Typical Sound Power 83 dB L_{WA} also on the screened second floor roof area with the process chillers.
- Two AHUs and other ancillary plant in an enclosed rooftop plant rooms but drawing fresh air and discharging extract air to the 3rd floor roof. Attenuators fitted to all atmosphere-side and room-side intakes and discharges.
- A standby diesel generator in an acoustic enclosure typically specified to achieve a sound pressure level of 75 dB(A) at 1m. This is located some 93m to the north away from Mount Road.

As details of the VRF condensers and process chiller plant to be provided in the 2nd floor screened roof are unknown it has been assumed that there are 8 No. units all with a sound power of 83 dB L_{WA} . This is thought to be a relatively high noise level for these units and is likely to be conservative.

6.2 Calculations

Preliminary plant noise calculations have been carried out to assess the impact of the typical plant selections identified above. The calculations take into account distance loss and shielding based on the locations of the plant. The calculations are provided in Appendix B together with an indicative section showing the shielding assumed. It is assumed in the first instance that all plant is operational except for the diesel generator which is assessed separately.

6.3 Mitigation

The following mitigation is assumed:

- It is assumed that a 1200mm long attenuator is fitted to the AHU intakes and a 1500mm long attenuator is fitted to the discharges. Both AHU intakes and discharges should be orientated along the east-west axis, that is intakes from the west and discharge to the east (or vice versa). Line of sight shielding (5dB) is assumed for the roof top AHU outlets/inlets. This can typically be achieved by parapet shielding from the edge of the roof.
- The air source heat pumps on the second-floor roof at the rear are screened by the central 3rd floor.
- The VRF and process chillers are screened by the 3rd floor area and by a screened section to the west and south. The screening should take the form of a solid barrier to the west. The southern side could be louvred to permit airflow using standard non-acoustic weather louvres.

6.4 Context and Uncertainty

BS 4142 requires consideration of context and uncertainty. In this case, the context is that the building is replacing an existing building and plant noise (probably from the leisure centre) is already audible at the site.

The background noise measurements are also subject to uncertainty. However, to allow for a conservative assessment the typical values have been set at below the lower end of the measured values. Therefore, uncertainty will not unduly affect the setting of the noise limits.

The calculations are also subject to uncertainty and at present only preliminary calculations have been made. This can be refined when detailed plant selections are made available.

6.5 Results

The specific plant noise level predicted at the residential receptor considering the above mitigation is 40 dB(A). This is comfortably within the daytime limit of 45 dB L_{Af} and within the evening limit of 40 L_{Af}. Noise levels however exceed the proposed evening limit of 37 dB L_{Af}. Note however that it is not expected all plant is operational all night, partly as the building will have reduced occupancy and because there is less cooling demand at night. Therefore, it is likely that this will ensure the night-time noise limits can be met. Note also that many condenser units are available with a night-setback mode, and this could also be utilised to reduce noise levels at night. This can be confirmed at the time of detailed design. The preliminary assessment assumes that the plant does not exhibit any of the character corrections which would result in the rating level being higher than the specific level.

6.6 Standby Diesel Generator

The diesel generator is not included in the calculations detailed above as it would not be running unless it is being tested or due to an emergency situation such as a power cut. The predicted noise level from the diesel generator is 35 dB(A) at Mount Road considering only distance loss. This is well within the proposed noise limit in an case, and usually limits for emergency plant can be set much higher than that for general services. The generator would be tested for a short-time typically once per month during daytime hours only and therefore will not result in any loss in amenity. We would propose that the standby generator noise limit be 5dB above the daytime background level, although the levels predicted are well below that.

7 Conclusions

This report sets out a noise assessment for the new CDC and Endoscopy building at Hinckley Hospital. Noise limits have been derived from a noise survey carried out in accordance with BS 4142. The limits are set to ensure a low impact according to BS 4142 and will ensure any noise is limited to below the lowest observed adverse effect level according to planning guidance.

The limits could be implemented as planning conditions. Preliminary plant noise calculations have been carried to demonstrate that typical plant selections can meet the limits with the mitigation described in this report.

HINCKLEY HOSPITAL
Plant Noise Assessment for New Endoscopy and CDC Wing
Appendix A – Tabulated Survey Data



Time	L _{Aeq} dB	L _{Amax,F} dB	L _{AF90} dB	Time	L _{Aeq} dB	L _{Amax,F} dB	L _{AF90} dB
04/04/2023 16:30	60.1	80.4	44.0	05/04/2023 04:30	47.6	65.4	37.6
04/04/2023 16:45	59.9	71.9	45.0	05/04/2023 04:45	51.2	68.5	39.0
04/04/2023 17:00	61.9	81.8	45.0	05/04/2023 05:00	51.7	68.1	40.5
04/04/2023 17:15	59.5	71.5	44.4	05/04/2023 05:15	54.6	75.9	40.8
04/04/2023 17:30	60.4	80.2	45.8	05/04/2023 05:30	55.2	74.3	43.0
04/04/2023 17:45	60.3	71.7	44.0	05/04/2023 05:45	58.0	71.9	46.3
04/04/2023 18:00	59.6	74.4	45.3	05/04/2023 06:00	54.6	71.7	44.0
04/04/2023 18:15	59.6	71.2	45.9	05/04/2023 06:15	55.8	75.5	44.8
04/04/2023 18:30	59.1	76.5	43.3	05/04/2023 06:30	56.8	72.8	45.2
04/04/2023 18:45	58.5	76.4	43.6	05/04/2023 06:45	56.0	73.9	44.5
04/04/2023 19:00	59.5	80.8	42.5	05/04/2023 07:00	56.2	73.4	45.1
04/04/2023 19:15	58.1	73.0	42.3	05/04/2023 07:15	63.7	83.6	47.7
04/04/2023 19:30	57.6	71.8	42.5	05/04/2023 07:30	60.0	74.6	47.3
04/04/2023 19:45	59.2	74.2	44.8	05/04/2023 07:45	61.4	72.5	48.7
04/04/2023 20:00	57.6	71.8	41.7	05/04/2023 08:00	60.4	73.8	47.3
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04/04/2023 22:00	52.2	69.6	41.2	05/04/2023 10:00	60.6	74.0	46.8
04/04/2023 22:15	52.5	71.4	40.4	05/04/2023 10:15	59.4	70.4	46.0
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04/04/2023 23:00	49.6	69.5	39.0				
04/04/2023 23:15	48.7	68.7	38.6				
04/04/2023 23:30	48.4	70.3	37.9				
04/04/2023 23:45	45.6	69.0	38.2				
05/04/2023 00:00	44.9	65.5	38.4				
05/04/2023 00:15	41.3	63.8	37.4				
05/04/2023 00:30	38.9	49.4	36.9				
05/04/2023 00:45	39.0	54.6	36.3				
05/04/2023 01:00	39.1	51.4	36.4				
05/04/2023 01:15	39.9	50.6	37.2				
05/04/2023 01:30	46.3	69.4	37.2				
05/04/2023 01:45	48.0	71.9	37.3				
05/04/2023 02:00	39.5	51.0	36.6				
05/04/2023 02:15	40.2	52.2	36.7				
05/04/2023 02:30	39.1	53.5	36.5				
05/04/2023 02:45	40.6	65.8	36.2				
05/04/2023 03:00	53.2	70.2	37.2				
05/04/2023 03:15	52.0	69.2	38.3				
05/04/2023 03:30	52.0	70.1	38.6				
05/04/2023 03:45	49.3	70.6	36.7				
05/04/2023 04:00	47.9	65.8	36.1				
05/04/2023 04:15	48.3	62.8	37.4				

