



Barwell Medical Centre, Leicester

Plant noise impact assessment (Planning)

9776.3

30th April 2024

Revision B



Barwell Medical Centre, Leicester

Plant noise impact assessment

9776.3A

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2 Summary

- 2.1 Apex Acoustics has conducted a noise impact assessment for the proposed external plant equipment and heat recovery units supply/exhaust ducts at Barwell Medical Centre in Leicester. This assessment was commissioned by GF Tomlinson Building Ltd to ensure compliance with Planning Condition 10, which requires adherence to BS 4142:2014 to avoid annoyance to nearby residents.
- 2.2 The existing acoustic environment was characterized using background noise measurements previously conducted by Hunter Acoustics.
- 2.3 Noise emission data was provided by the manufacturers for the proposed plant items, which include air source heat pumps, VRV units, and heat recovery units. Sound propagation modelling using the PEMARD OTL Suite software, which implements ISO 9613, was carried out to predict specific noise levels at the nearest sensitive receptors (NSR).
- 2.4 The initial assessment found that without mitigation, the plant noise would likely cause significant adverse impacts, exceeding the BS 4142 criteria. To reduce noise to acceptable levels, acoustic enclosures and in-duct attenuators were recommended for the air source heat pumps, VRV units, and heat recovery unit ducts.
- 2.5 With these mitigation measures incorporated into the model, the predicted rating noise levels meet the requirements of Planning Condition 10, with a 2 dB exceedance at night considered acceptable given the context.
- 2.6 In conclusion, the plant noise emissions are expected to avoid adverse impacts on residents, and approval is recommended contingent on implementing the specified noise control solutions.

3 Introduction

- 3.1 GF Tomlinson Building Ltd has commissioned Apex Acoustics to conduct a noise impact assessment for the external plant equipment and the supply and exhaust ducts of the heat recovery units at Barwell Medical Centre in Leicester.
- 3.2 Planning Condition 10 for the development, requires that a plant noise assessment must be conducted in accordance with BS 4142:2014 (Reference 1), to ensure that the proposed use does not become a source of annoyance to nearby residents.
- 3.3 This report encompasses a thorough review and assessment of the relevant plant items currently proposed for Barwell Medical Centre. For visual reference, the external plant items' location is depicted in Figure 1.

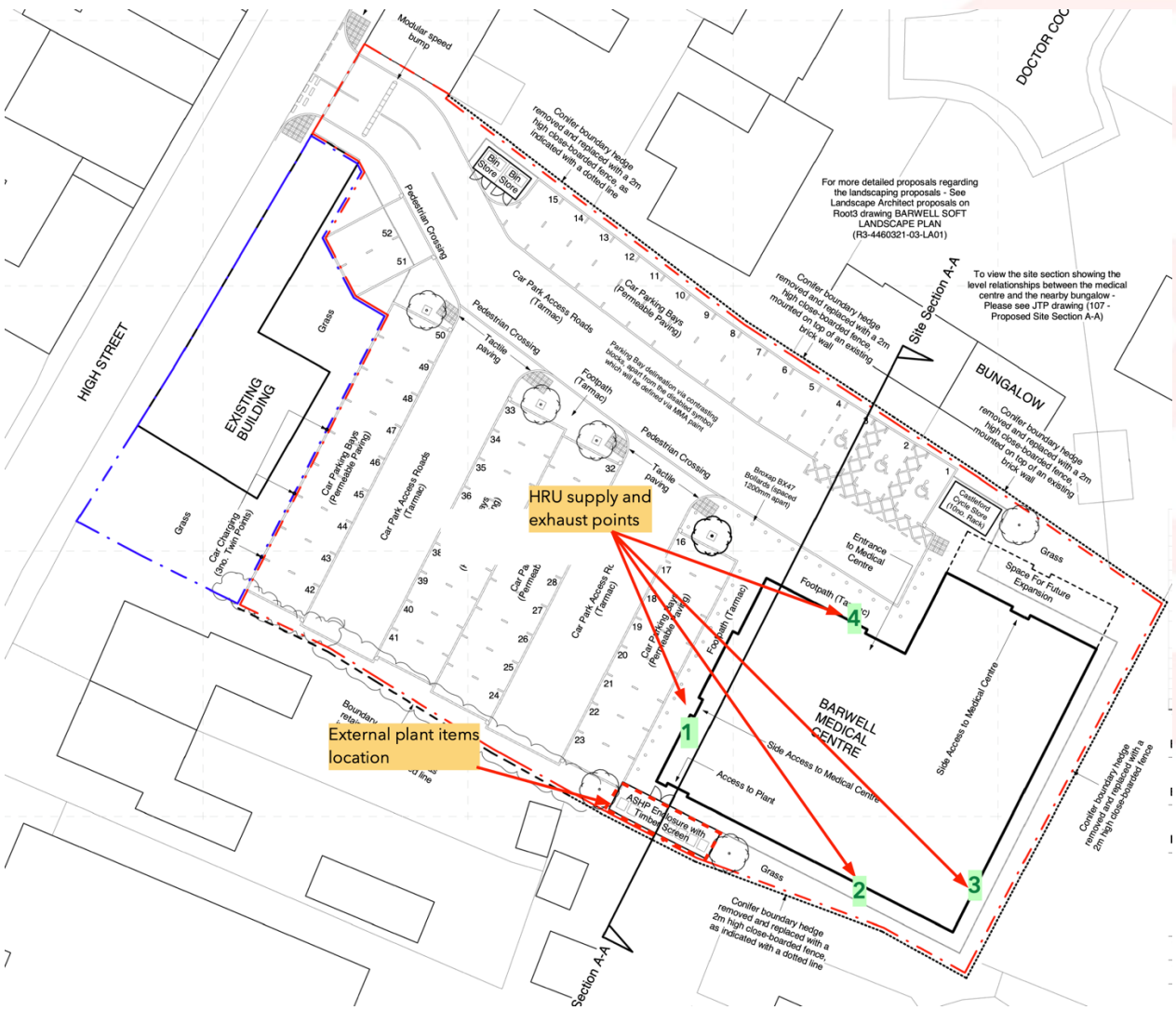


Figure 1: External plant items and HRUs supply and exhaust ducts location (source: doc. Ref. 151236_JTP_00_XX_DR_A_0504_C05)

4 Relevant criteria

- 4.1 Local Authority planning requirements
- 4.2 Planning permission for Barwell Medical Centre has been granted by Hinckley & Bosworth Borough Council under application number 20/00540/FUL. Planning Condition 10 relates to the control of noise emissions from new plant equipment associated with the development requiring an assessment to be carried out in accordance with BS 4142:2014. An extract from the decision notice containing the specifics of Planning Condition 10 is presented in Figure 2.
- 10. Prior to occupation, a plant noise assessment in accordance with BS4142:2014+A1:2019 should be carried out and submitted in writing to and approved by the local planning authority.
Reason: To ensure that the proposed use does not become a source of annoyance to nearby residents in accordance with Policy DM7 and DM10 of the adopted Site Allocations and Development Management Policies Development Plan Document (2016).
- Figure 2: Extract from planning decision notice showing Planning Condition 10
- 4.3 BS 4142:2014 defines an assessment method to quantify the potential level for adverse impact from commercial and/or industrial noise sources impacting upon sound-sensitive receptors, i.e. residential properties. The method estimates the impact significance by comparing the Rated noise against the background sound levels, as summarised below:
 - a) Typically, the greater this difference, the greater the magnitude of the impact.
 - b) A difference of around +10 dB 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.
- 4.4 The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source 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 sources having a low impact, depending on the context.
- 4.5 The terminology used in BS 4142 to describe the various levels of potential adverse impact with respect to the PPG-N noise hierarchy, is summarised Appendix A.
- 4.6 Considering the context, for this assessment, the criteria for low impact is used, which means the rating noise should not exceed the background noise. This is in line with a LOAEL (Lowest Observable Adverse Effect Level) as defined by NPSE (Noise Policy Statement for England).

5 Existing acoustic environment

- 5.1 An environmental noise assessment report with information regarding the background noise at the development vicinity was issued by Hunter Acoustics on the 9th of March 2021 (Doc. Ref. 6080/ENS1_Rev1). This assessment focused on measuring background noise at positions A and B as highlighted in Figure 3. The results of the survey are shown in Figure 4 and Figure 5.
- 5.2 Based on the survey results and following the guidance provided in the ANC BS 4142 technical note (Reference 4), the representative background sound level for the day and night time at both positions are presented in Table 1.

Assessment period	Representative L _{A90} (dB)
Daytime (07:00 – 23:00 hrs)	43
Night-time (23:00 – 07:00 hrs)	37

Table 1: Background sound levels representative of the assessment periods



Figure 3: Monitoring positions (source: Hunter Acoustics Doc. Ref. 6080/ENS1_Rev1)

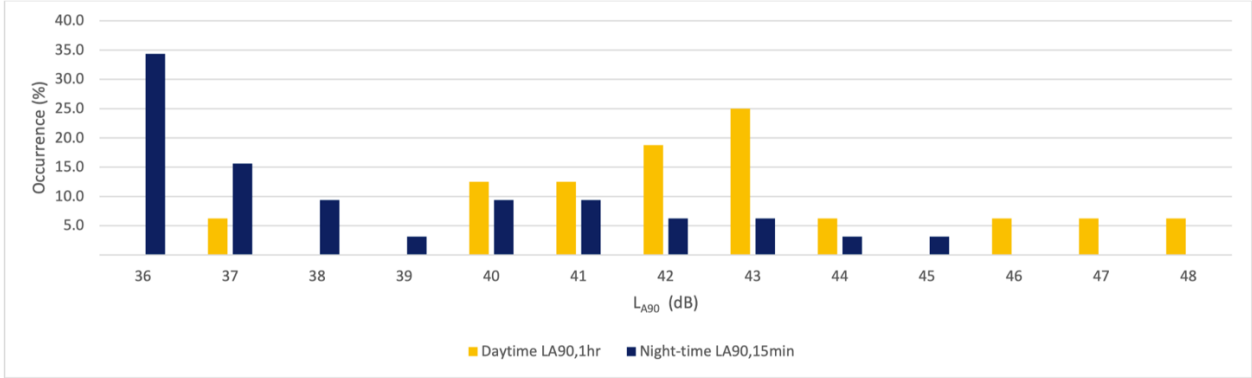


Figure 4: Statistical Analysis of Background Sound Levels Measured at Position A

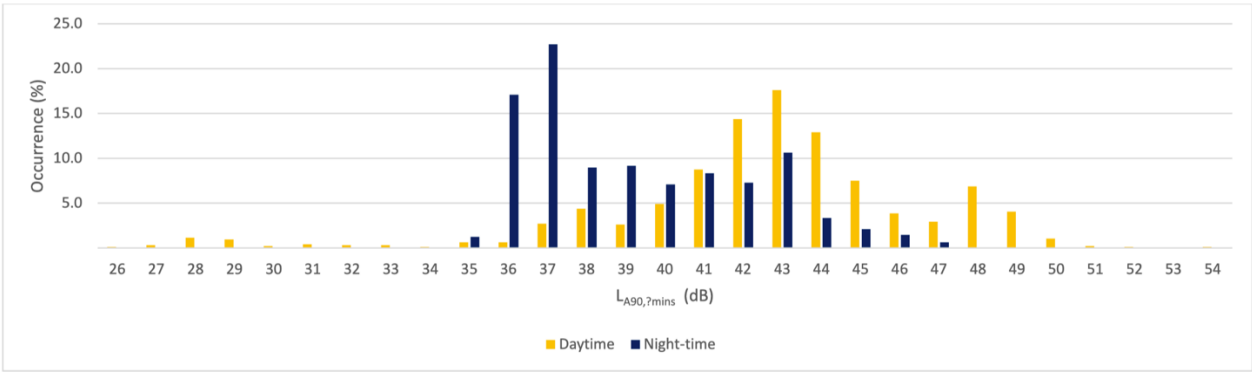


Figure 5: Statistical Analysis of Background Sound Levels Measured at Position B

6 Proposed Units

6.1 The proposed mechanical units which emit noise and therefore may contribute to noise impacts at sensitive receivers nearby consist of the units stated in Table 2. The overall location for each source is highlighted in Figure 1.

Unit type	Manufacturer	Model	No. proposed
ASHP	Mitsubishi	QAHV-N560YA	1
VRV	Daikin	REYQ16U	2
ASHP	Daikin	RZA71NV1	2
HRU	Eurovent	Topvex FR06EL-R-CAV (94542)	1
HRU	Systemair	VSC 1500 EL	2
HRU	Systemair	VSC 400 EL	1

Table 2: Proposed plant items

6.2 Noise Emission Characteristics

6.3 The noise emissions characteristics of each relevant mechanical unit, as supplied by the mechanical engineer are stated in Table 3.

6.4 It's worth noting that the data for the Mitsubishi unit is provided by the manufacturer in terms of sound pressure levels at 1 metre from the unit (1.5 metres in height). To derive the sound power levels, we applied the principles outlined in BS ISO 3744 (Reference 6). This methodology accounts for the unit's dimensions.

Reference	Model	Data type	dB(A)	Single-octave band centre frequency (Hz)						
				Linear noise levels (dB)						
				63	125	250	500	1k	2k	4k
ASHP	QAHV-N560YA	Lw (Standard Heating mode)	74	87	74	75	72	68	64	60
CU01 / CU02	REYQ16U	Lw (Standard Heating mode)	86	94	90	85	85	77	75	73
CU03 / CU04	RZA71NV1	Lw (Standard cooling mode)	64	-	-	-	-	-	-	-
HRU 01	Topvex FR06EL-R-CAV (94542)	In-duct Lw (Outdoor)	64	75	74	70	51	48	41	32
		In-duct Lw (Exhaust)	77	79	76	83	71	72	67	52
HRU 02	VSC 1500 EL	In-duct Lw (SUP)	-	86	82	84	79	71	70	64
		In-duct Lw (ETA)	-	79	75	70	60	54	45	42

Reference	Model	Data type	dB(A)	Single-octave band centre frequency (Hz)						
				Linear noise levels (dB)						
				63	125	250	500	1k	2k	4k
HRU 03	VSC 1500 EL	In-duct Lw (SUP)	-	84	78	80	74	67	65	58
		In-duct Lw (ETA)	-	78	73	68	59	52	43	40
HRU 04	VSC 400 EL	In-duct Lw (SUP)	-	77	74	73	71	64	61	58
		In-duct Lw (ETA)	-	72	69	64	58	45	39	38

Table 3: Plant items noise emission characteristics

7 Assessment of Noise Impacts

- 7.1 To identify the specific noise levels at the nearby NSRs, a sound propagation model was carried out using the PEMARD OTL Suite software (Reference 8), based on the noise emission characteristics of each item that were previously mentioned.
- 7.2 The OTL Suite software predicts outdoor sound propagation based on the ISO 9613 standard (Reference 9). The main model parameters and assumptions are summarized in Table 4. It is assumed that the equipment could operate continuously for one hour during the day and for fifteen minutes at night. This is a prudent assumption.
- 7.3 To calculate the sound power levels (SWL) at the supply and exhaust points of the HRUs, the losses due to duct lengths, elbows, end reflection loss, and other characteristics were determined following the principles outlined in CIBSE Guide B4 (Reference 10). The resultant levels have been incorporated into the OTL Suite software. Details of the calculations carried out can be found in Appendix C.
- 7.4 The calculated specific noise at 1 metre from the nearby facades is shown in Figure 6.

Parameter	Source	Details
Model dimensions	Google Earth	British Transverse Mercator coordinates
Site location and layout	Google Earth	-
Topography	Site observations and Google Street view	Modelled with no changes in topography
Building heights	Site observations and Google Street view	3 m per storey + 3 m roof (residential properties)
Receptor positions	Site observations and Google Street view	A receivers grid (1x1 metres) has been defined at 1 meter from each NSR façade
Building and barrier absorption coefficient	ISO 9613-2	0.21 to represent a reflection loss of 1 dB
G, Ground factor	ISO 9613-2	Hard ground, G = 0; Porous ground, G = 1 (locally on model)
Max. order of reflection and diffraction	Apex Acoustics	Order of reflections: 2 Order of diffraction for each emission path: 1

Table 4: Modelling parameters and assumptions

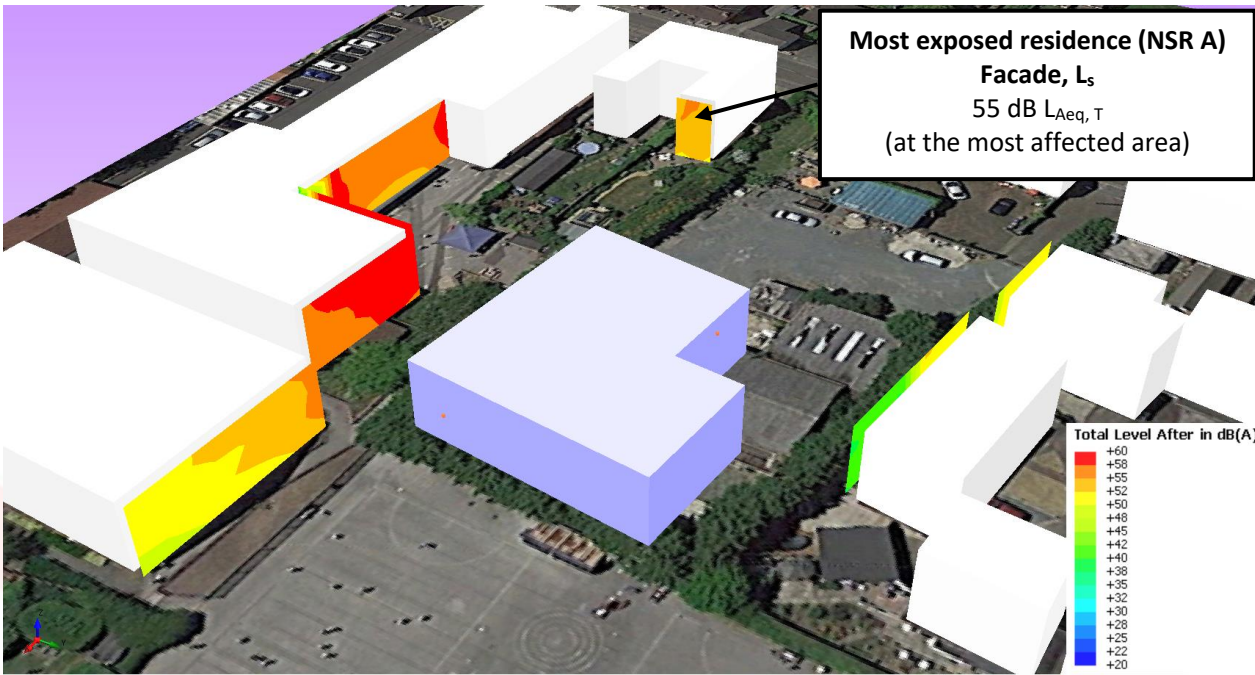


Figure 6: Calculated specific noise levels at 1 meter from the nearby NSRs facades

- 7.5 Noise Impacts at NSR A
- 7.6 As required by planning condition 10, based on the determined representative background noise level, a BS 4142 assessment has been carried out for the most exposed façade area of NSR A and its results are presented in Table 5. It can be seen that, without further mitigation, the assessment indicates the likelihood of a significant adverse impact at NSR A. Further mitigation measures are required to reduce the impacts appropriately.

Parameter	Daytime assessment	Night-time assessment	Commentary
Background sound level	43 dB LA90, 15 min	37 dB LA90, 15 min	Considered representative of the assessment period based on statistical analysis detailed in Section 5.
Highest specific sound level L _s , due to all sources	55 dB LAeq, 1-hr	55 dB LAeq, 1-hr	The on-time for the sources during the assessment period is discussed in Section 7.2.
Acoustic feature correction	+ 3 dB	+ 3 dB	The following penalties are considered applicable: • Tonality – 0 dB; • Impulsivity – 0 dB; • Intermittency – 3 dB; • Other – 0 dB.
Rating level, L _{Ar,Tr}	58 dB	58 dB	
Uncertainty of assessment	-	-	Background data was obtained over 24 hours. The method used for the calculations has reduced uncertainty in the calculated impact.
Excess of L _{Ar,Tr} over background sound level	+ 15 dB	+ 21 dB	The result indicates the likelihood of a significant adverse impact at the proposed development.

Table 5: Assessment of current impacts at NSR A in line with BS 4142

8 Mitigation measures

- 8.1 To determine appropriate noise mitigation measures, the same OTL Suite software model and parameters referred to in Section 7 were used. A suitable mitigation strategy must reduce the noise levels in such a way that the criteria set out by Planning Condition 10 are met.
- 8.2 Multiple mitigation strategies were simulated to identify the most feasible and effective options. Due to the height of NSR A facades, noise barriers are not adequate to sufficiently reduce the predicted noise levels at each NSR upper floor. Therefore, the recommended mitigation strategy for each relevant mechanical unit is shown in Table 6.
- 8.3 The octave band attenuation used to determine suitable enclosures has been provided by Ambient Acoustics via email. However, if required, enclosures to provide similar attenuation for each relevant octave band can also be used if preferred. For reference, the octave band attenuation details for the enclosures provided by Ambient Acoustics are stated in Table 7.
- 8.4 The predicted specific noise levels at NSR A, with the proposed enclosure in place, are shown in Figure 7.

Reference	Manufacturer	Model	Recommended Mitigation
ASHP	Mitsubishi	QAHV-N560YA	Full enclosure to provide an average attenuation of 16 dB(A)
CU01 / CU02	Daikin	REYQ16U	Full enclosure to provide an average attenuation of 18 dB(A)
CU03 / CU04	Daikin	RZA71NV1	No required attenuation
HRU 1	Eurovent	Topvex FR06EL-R-CAV (94542)	1.5 metres in-duct attenuator (Outlet and Inlet - atmospheric side)
HRU 2	Systemair	VSC 1500 EL	0.9 metres in-duct attenuator (Outlet and Inlet - atmospheric side)
HRU 3	Systemair	VSC 1500 EL	1.5 metres in-duct attenuator (Outlet and Inlet - atmospheric side)
HRU 4	Systemair	VSC 400 EL	0.9 metres in-duct attenuator (Outlet and Inlet - atmospheric side)

Table 6: Proposed Mitigation Measures for each Mechanical Unit

Model	Data type	Single-octave band centre frequency (Hz)							
		Linear noise levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Ambient Acoustics 16 dBA rated full acoustic enclosure	Acoustic attenuation dB	5	9	14	20	30	30	27	20
Ambient Acoustics 18 dBA rated full acoustic enclosure		6	10	14	20	30	33	30	22

Table 7: Acoustic Enclosures Performance (Provided by Ambient Acoustics)

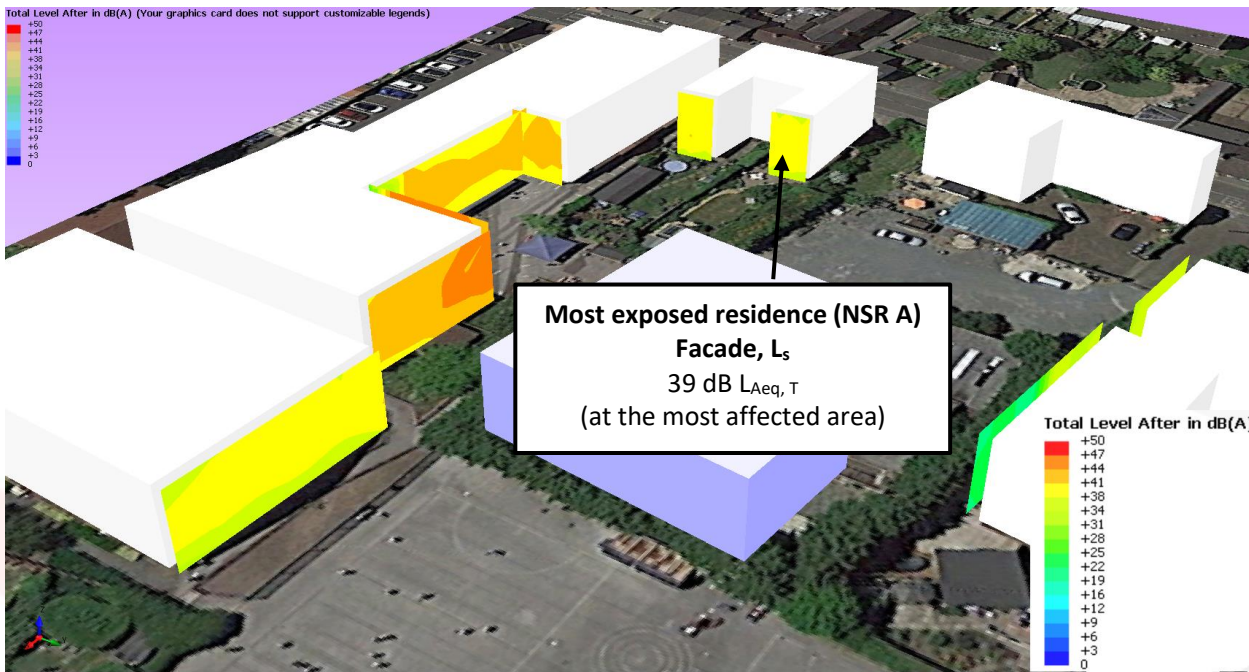


Figure 7: Calculated specific noise levels at 1 meter from the nearby NSRs facades (with proposed mitigation)

- 8.5 Noise Impacts at NSR A with Mitigation
- 8.6 Table 8 presents the results of the BS 4142 noise impact assessments for NSR A with mitigation in place. Due to the relatively low specific noise levels, no penalties are applied. With the proposed mitigation in place, the assessment indicates the noise impacts at NSR A will exceed the identified background sound levels by +2 dB at night.
- 8.7 While this technically exceeds the numerical threshold, it is important to consider the context, i.e. this exceedance would occur during late night hours when residents are likely inside their residences. The dwelling's indoor residual sound would further mask the proposed plant noise during the night, even with windows open. Furthermore, the recommended solutions are the most effective mitigation in this case and therefore, the noise from the proposed unit is considered mitigated as far as possible.

Parameter	Daytime assessment	Night-time assessment	Commentary
Background sound level	43 dB L _{A90} , 15 min	37 dB L _{A90} , 15 min	Considered representative of the assessment period based on statistical analysis detailed in Section 5.
Highest specific sound level L _s , due to all sources	39 dB L _{Aeq} , 1-hr	39 dB L _{Aeq} , 1-hr	The on-time for the sources during the assessment period is discussed in Section 7.2.

Acoustic feature correction	+ 0 dB	+ 0 dB	The following penalties are considered applicable: • Tonality – 0 dB; • Impulsivity – 0 dB; • Intermittency – 0 dB; • Other – 0 dB.
Rating level, $L_{A,r,Tr}$	39 dB	39 dB	
Uncertainty of assessment	-	-	Background data was obtained over 24 hours. The method used for the calculations has reduced uncertainty in the calculated impact.
Excess of $L_{A,r,Tr}$ over background sound level	- 4 dB	+ 2 dB	The result indicates the likelihood of low impacts

Table 8: Assessment of current impacts at NSR A in line with BS 4142 (with proposed mitigation)

9 Conclusion

- 9.1 This document presents a noise impact assessment for proposed plant equipment at the Barwell Medical Centre in Leicester. The assessment aims to ensure compliance with Planning Condition 10, which requires adherence to BS 4142:2014 for residential receptors.
- 9.2 Calculation of noise emissions shows the unmitigated plant noise would exceed Planning Condition 10 at the nearby NSRs. To mitigate this, mitigation measures are recommended, as detailed in Section 8.
- 9.3 With the proposed mitigation in place, the noise impacts are considered acceptable and the requirements of Planning Condition 10 are deemed met.
- 9.4 In summary, the proposed acoustic enclosure enables compliance with the identified assessment criteria for the new plant equipment at Barwell Medical Centre. Approval is recommended subject to implementing the proposed mitigation strategy.

10 References

- 1 BS 4142 2014: A1+2019, Method for rating and assessing industrial and commercial sound.
- 2 National Planning Policy Framework, Ministry of Housing, Communities & Local Government, December 2023.
- 3 Noise Policy Statement for England, Department for Environment, Food and Rural Affairs, March 2010.
- 4 Association of Noise Consultants (ANC) BS 4142:2014+A1:2019 Technical Note.
- 5 BS EN ISO 3740:2019 Determination of sound power levels of noise sources.
- 6 BS EN ISO 3744:2010 Determination of sound power levels and sound energy levels of noise sources using sound pressure. Engineering methods for an essentially free field over a reflecting plane.
- 7 Fläkt Woods, Practical guide to noise control, Fifth Edition, published by Fläkt Woods Limited
- 8 OTL Suite noise modelling software, version 4.0, PEMARD.
- 9 ISO 9613: Acoustics - Attenuation of sound during propagation outdoors.
- 10 Chartered Institution of Building Services Engineers. (2016). CIBSE Guide B4: Noise and vibration control for building services systems. CIBSE.
- 11 ISO 12913-1:2014 Acoustics, Soundscape, Part 1: Definition and conceptual framework

Appendix A Noise exposure hierarchy

Planning Practice Guidance - Noise				Significant adverse effect Adverse effect Low Impact An initial estimate of the impact of the specific sound may be obtained by subtracting the measured background sound level from the rating level. Typically, the greater this difference, the greater the magnitude of impact + 10 dB + 5 dB 0 dB
Noise	Example of outcomes	Increasing effect level	Action	
Present and very distributive	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	
Present and distributive	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	
Significant Observed Adverse Effect Level (SOAEL)				
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	
Lowest Observed Adverse Effect Level (LOAEL)				
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	
No Observed Adverse Effect Level (NOAEL)				
Not present	No effect	No Observed Effect	No specific measures required	
No Observed Effect Level (NOEL)				

Table 9: PPG-N Noise Exposure Hierarchy and BS 4142 initial estimate of impact

Appendix B Professional qualifications and competence

- B.1 All Apex Acoustics consultants work under the close supervision of a member who holds a qualification in acoustics and is a member of the IOA.
- B.2 This can be verified by searching the Institute of Acoustics' list of Members, available here, with the surname of the consultant.
- <http://www.ioa.org.uk/membership-check>
- B.3 Apex Acoustics is a member of the Association of Noise Consultants (ANC). The ANC is a trade organisation which seeks to raise the standards of acoustic consultancy and as such there are barriers to entry to ensure members' competency.
- B.4 This report has been completed by an appropriately qualified and experienced acoustic consultant.



Appendix C Calculation Details

POTTORFF®

Pottorff AIM Software
HVAC Noise Prediction Tool

Project Name:

Location:

Architect:

Mechanical Engineer:

Contractor:

Project/Reference Number:

Engineered By:

Company:

Run Date: 26/04/2024

Notes:

HRU 01
Calculation Summary

Element		Properties	NC	Octave Midband Frequency, Hz							dB(A)
				63	125	250	500	1K	2K	4K	
1	HRU 01	Criteria: NC-65	>65	69	72	80	68	69	64	49	74
2	Return Path (1)	Criteria: NC-65									
3	HRU01			79	76	83	71	72	67	52	
4	Circular Elbow Radius	349 (0)		0	0	-1	-2	-3	-3	-3	
				0	0	0	0	0	0	0	
5	End Reflection Loss	349 (Flush)		-11	-6	-2	-1	0	0	0	
6	SUM		>65	68	70	80	68	69	64	49	74
7	Supply Path (Outdoor 1)	Criteria: NC-65									
8	HRU01			75	74	70	51	48	41	32	
9	Circular Elbow Radius	349 (0)		0	0	-1	-2	-3	-3	-3	
				0	0	0	0	0	0	0	
10	End Reflection Loss	349 (Flush)		-11	-6	-2	-1	0	0	0	
11	SUM		60	64	68	67	48	45	38	29	59