



Wythenshawe Hospital

Plant noise impact assessment

PR1334-APX-XX-XX-RP-AC-100001

8th July 2025

Revision A01



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Prepared for

Vanguard Healthcare Solutions Ltd

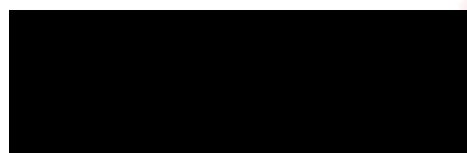
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1 Contents

1	Contents	2
2	Summary	3
3	Introduction.....	4
4	Planning policy and noise criteria	5
5	Existing acoustic environment	6
6	Noise sources.....	7
7	Assessment results	8
8	Conclusion	9
9	References.....	9
Appendix A	Noise exposure hierarchy.....	10
Appendix B	Residual and background sound levels.....	11
Appendix C	Plant manufacturer noise data.....	13
Appendix D	AHU noise source levels	14
Appendix E	Noise transmission and propagation	16
Appendix F	Professional qualifications and competence	17

2 Summary

- 2.1 This report has been prepared in support of a Planning Application for new modular hospital theatres proposed at Wythenshawe Hospital.
- 2.2 Noise emission from the proposed plant has been calculated using the methodology in BS ISO 9613, Reference 7.
- 2.3 Plant details were provided by the mechanical engineers.
- 2.4 The key findings are as follows:
- **Impact on Wythenshawe Hospital:** The highest calculated plant noise level at the nearest existing hospital window is 43 dBA. This level is well below the measured daytime background sound level limit of 56 dB LA90 required in HTM 08-01, Reference 11. Assuming a 15 dB sound reduction for an open window, the resulting internal noise level would be 28 dBA, which satisfies the most stringent internal noise limits for clinical spaces as specified in HTM 08-01. Therefore, the external plant noise levels comply with the requirements of HTM 08-01.
 - **Impact on Off-Site Receptors:** The nearest off-site sensitive receptors are residential properties located approximately 200 metres from the proposed site. A worst-case assessment, which does not account for the significant acoustic screening from existing hospital buildings, calculates a plant noise level of 20 dBA at this location. In practice, noise levels are expected to be substantially lower and likely inaudible.
- 2.5 Based on current proposals, it is calculated that the current proposals achieve the Local Authority requirements without requiring a scheme for the mitigation of noise.

3 Introduction

- 3.1 New modular hospital theatres have been proposed at Wythenshawe Hospital; the site location is shown in Figure 1.
- 3.2 Apex Acoustics has been commissioned to undertake a noise survey and assessment of the noise from mechanical plant associated with the development in support of a Planning Application.
- 3.3 The scope of our instruction includes:
- Measurement of the existing noise environment over a 24-hour period at a single location representative of the nearest noise-sensitive receptor (in this case it is the hospital itself);
 - Analysis of proposed source noise levels, using manufacturers' data provided by the client;
 - Calculate noise propagation and assess the impact in accordance with BS 4142: 2014;
 - Advise on a scheme for noise mitigation to satisfy Local Authority planning requirements.
- 3.4 This report presents the evaluation of the potential noise impact from plant associated with the proposed development on the identified nearest noise-sensitive receptors (NSRs), both on and off-site, in support of a Planning Application.
- 3.5 The nearest off-site NSRs are identified as residential properties to the east of Wythenshawe Hospital on Stapleford Close. The nearest house is approximately 200 m from the proposed site and is completely screened from view by existing hospital buildings.
- 3.6 The nearest existing hospital building windows to the proposed plant are shown in Figure 2.
- 3.7 This assessment is based on the proposed plant details identified by the mechanical engineers.
- 3.8 The potential noise impact from the sources identified is calculated and rated according to the BS 4142 methodology, Reference 1.



Figure 1: Proposed site, measurement position and identified off-site NSRs

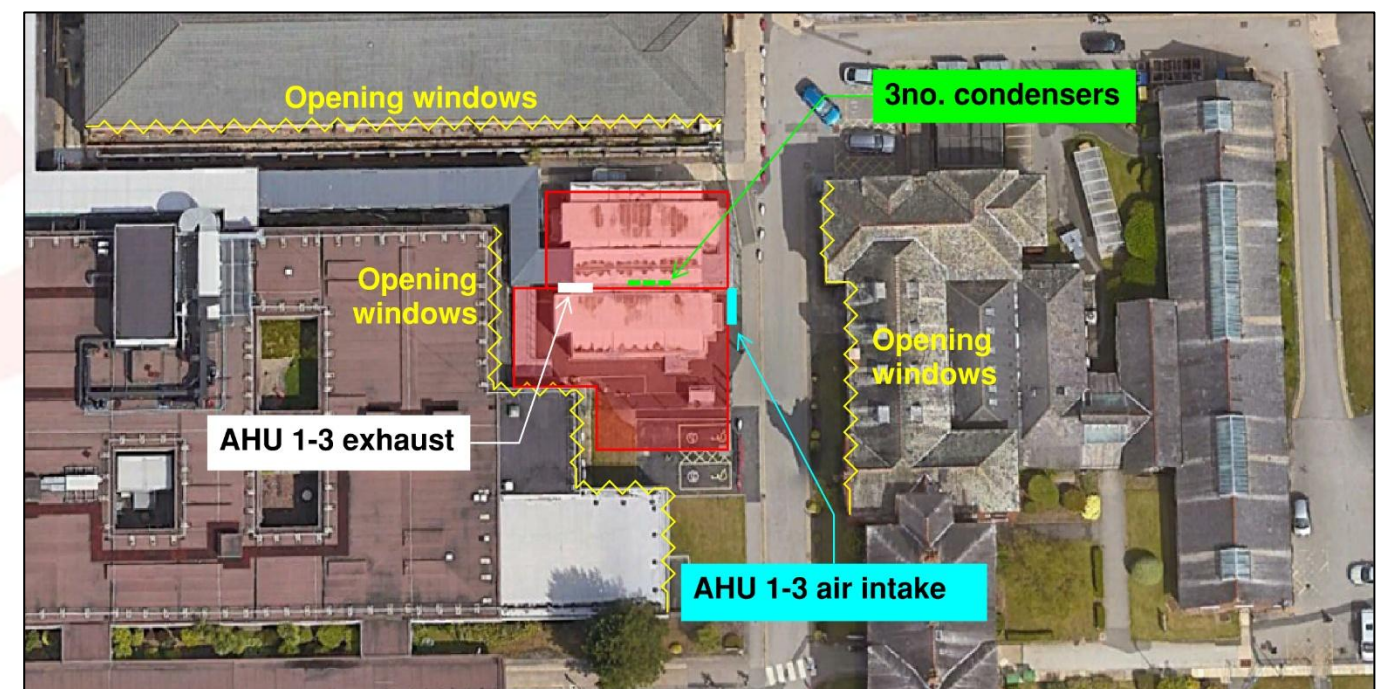


Figure 2: nearest existing hospital building windows to the proposed plant

4 Planning policy and noise criteria

4.1 National Planning Policy Framework (NPPF)

4.2 The National Planning Policy Framework (NPPF) Reference 2, sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally-prepared plans for housing and other development can be produced. In respect of noise, Paragraph 187, 198 and 200 of the NPPF states the following:

4.3 Paragraph 187:

"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 or land instability..."

4.4 Paragraph 198:

"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 life⁶⁵ [See Explanatory Note to the Noise Policy Statement for England];

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;"

4.5 Paragraph 200:

"Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."

4.6 Noise Policy Statement for England (NPSE)

4.7 The Noise Policy Statement for England, Reference 3, states three policy aims as follows:

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- 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."*

4.8 The NPSE defines adverse noise impact as follows:

- No Observed Effect Level (NOEL)
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.
- Lowest Observed Adverse Effect Level (LOAEL)
This is the level above which adverse effects on health and quality of life can be detected.
- Significant Observed Adverse Effect Level (SOAEL)
This is the level above which significant adverse effects on health and quality of life occur

4.9 The first two aims of the NPSE require that no significant adverse impact should occur and that, where a noise level which falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect, then according to the explanatory notes in the statement:

"... all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur."

4.10 Planning Practice Guidance – Noise

4.11 Further Government guidance on how planning can manage potential noise impact in new development is outlined in Planning Practice Guidance (PPG-N) notes on the Government website: www.gov.uk/guidance/noise--2

4.12 BS 4142

4.13 The terminology used in BS 4142 to describe the various levels of potential adverse impact is respect to the PPG-N noise hierarchy, are summarised Appendix A.

4.14 Local planning policy

4.15 Supplementary detailed planning guidance regarding noise is provided by Manchester City Council (MCC) in a Technical Guidance note entitled ‘Planning and Noise’ published in July 2022, Reference 10.

4.16 The Technical Guidance states that it:

“aims to provide help and advice in relation to noise in a planning context to encourage good acoustic design. It outlines what is expected in relation to current guidance and policy with the aspiration that new developments achieve the highest possible standards without compromising the health and wellbeing of people that live and work within the City of Manchester.”

4.17 In section 3.7.1.5 MCC’s criteria with regards to industrial and commercial sources (which includes plant) are stated as follows:

“BS 4142 should be used to assess the likely impact of noise from industrial and commercial sources at noise sensitive premises [...]

The development should be designed so as to achieve a rating level of 5dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location.”

4.18 Project design criteria

4.19 The noise impact from fixed plant associated with the development will require assessment to comply with the limits in HTM 08-01, Reference 11, at existing hospital buildings:

- Noise ingress through façade to satisfy the indoor building services noise limits in HTM 08-01; and
- Noise levels in any external areas normally occupied by staff or public (e.g. courtyards, landscaped areas) should not exceed the existing daytime background sound level or 50 dB L_{A90} (whichever is higher).

4.20 The most stringent HTM 08-01 internal ambient noise level limits are for wards and sleeping areas:

- 40 dB L_{Aeq, 1hr} daytime
- 35 dB L_{Aeq, 1hr} night-time

5 Existing acoustic environment

5.1 A noise survey was undertaken between 13:00 hours on the 9th July 2025 and 11:00 hours on the 11th July 2025 at the hospital.

5.2 No precipitation occurred during the measurement period.

5.3 The measurement position is shown in Figure 1.

5.4 The equipment used is listed in Table 1.

Equipment	Model	Serial no.
Sound Level Meter	NTi XL2	A2A-05832-E0
Calibrator	Larson Davis CAL 200	9462
Calibrator	Larson Davis CAL 200	13403

Table 1: Equipment used

5.5 Both meter and calibrator have current calibration certificates traceable to national standards. The sound level meter has been calibrated within the last two years and calibrator has been calibrated within the last year in accordance with the guidance of BS 4142; calibration certificates are available on request.

5.6 The equipment was field-calibrated before and after the measurements with no significant drift in sensitivity noted.

5.7 Weather conditions during the survey period were dry with wind speeds below 5 m/s.

5.8 Residual sound level, L_r

5.9 As the specific sound source under assessment is not yet operating on-site / was not operating during the noise survey period, the existing acoustic environment measured during the survey period is the L_r.

5.10 A time history of the measured L_r is shown in Appendix B.

5.11 Measured sound levels

5.12 The background sound level L_{A90}, was calculated from the L_r shown in Appendix B.

5.13 Statistical analysis is undertaken of the results of all the L_{A90,15min} data following the guidance of BS 4142, to determine a background sound level considered to be representative of the assessment period. Results of the analysis are shown in Figure 4 in Appendix B.

5.14 Based on the statistical analysis results, the background sound levels considered representative of the daytime and night time periods is shown in Table 2. Ambient noise levels are also presented.

Assessment period	Measured ambient noise levels L _{Aeq,1hr} (dB)	Background sound level L _{A90} (dB)
Daytime (07:00 – 23:00 hrs)	53-65	56
Night-time (23:00 – 07:00 hrs)	51-56	44

Table 2: Ambient and background sound levels representative of the nearest hospital façades

6 Noise sources

6.1 Proposed plant and associated noise levels

6.2 The mechanical plant is assessed based on plant details supplied by the mechanical engineers.

6.3 The location of the all the units have been taken from the mechanical engineers' drawings, Reference 4.

6.4 The proposed plant is summarised in Table 3.

Plant	Manufacturer	Model	No. proposed
Air handling unit (AHU) 1 & 2	Damvent	max.e2 06	2
Air handling unit (AHU) 3	Damvent	max.e2 09	1
Condenser (OU)	Daikin	FAA100B	3

Table 3: Proposed plant

6.5 Manufacturer supplied noise levels are shown in Appendix C.

6.6 The in-duct attenuator insertion losses used in the calculations are indicative of a 1.2 m attenuator with 50% free area and are shown in Table 4.

Attenuator ref.	Single-octave band centre frequency (Hz) In-duct attenuator insertion losses (dB)						
	63	125	250	500	1k	2k	4k
AHU intake / exhaust	2	6	11	20	23	19	12

Table 4: Proposed AHU in-duct insertion loss

6.7 If plant emitting higher noise levels than those accounted for in this report is proposed, or additional plant also proposed, the impact should be reassessed to check compliance with the noise limits.

6.8 Operation times

6.9 All plant is assumed to operate continuously during the daytime 1-hour and night-time 15-minute assessment periods; this is a prudent assumption.

7 Assessment results

- 7.1 Plant noise transmission and propagation outdoors to the receptors has been calculated according to ISO 9613, Reference 7.
- 7.2 The noise levels calculated at each receptor location are summarised in Table 5. Further details of the calculations are provided in Appendix D and Appendix E.

Receptor	Calculated specific sound level at receptor, L_s
Nearest hospital window to east	41 dBA
Nearest hospital window to west	43 dBA
Nearest hospital window to north	42 dBA
Nearest off-site receptor	20 dBA

Table 5: Calculated plant noise levels at nearest receptors

- 7.3 The calculation of noise levels at the nearest off-site receptor accounts for distance but not for screening provided by the existing hospital buildings. This is a simplified assessment and, as such, is a robust worst-case scenario as in reality screening from multiple buildings will substantially reduce noise levels further.
- 7.4 **Noise impact at the hospital**
- 7.5 The noise impact from fixed plant associated with the development shall comply with the limits in HTM 08-01, Reference 11, at existing hospital buildings:
- Noise ingress through façade to satisfy the indoor building services noise limits in HTM 08-01; and
 - Noise levels in any external areas normally occupied by staff or public (e.g. courtyards, landscaped areas) should not exceed the existing daytime background sound level or 50 dB L_{A90} (whichever is higher).
- 7.6 The highest plant noise level calculated at an existing hospital window is 43 dBA. Assuming a sound level difference of 15 dB through an open window, from outside to inside, this would result in an internal noise level of 28 dBA in the worst-case position. This is well below the most stringent HTM 08-01 internal noise limit for clinical spaces of 35 dB $L_{Aeq,1hr}$ at night in wards and sleeping areas.
- 7.7 Plant noise levels calculated at the nearest hospital façades are well below the measured background sound level of 56 dB L_{A90} during the day. Any external areas occupied by the public or staff are more distant than these façades, so plant noise levels will be lower.

- 7.8 External plant noise levels are therefore considered to comply with the requirements of HTM 08-01.
- 7.9 **Noise impact at off-site receptors**
- 7.10 A plant noise level of 20 dBA has been calculated at the nearest off-site sensitive receptor. As mentioned previously, this does not account for screening provided by existing hospital buildings. Screening from multiple buildings will substantially reduce noise levels further.
- 7.11 In practice, noise levels from the proposed plant will be inaudible at the nearest off-site receptor and further assessment is not necessary.

8 Conclusion

- 8.1 Based on the current development proposals it is calculated that the requirements of the Local Authority and HTM 08-01 are met.
- 8.2 The assessment indicates a low impact due to noise from new items of plant, corresponding to a "No Observed Effect Level" (NOEL) in alignment with the National Planning Policy Framework and Noise Policy Statement for England. Based on the current proposals, no additional noise mitigation measures are required.

9 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 2024.
- 3 Noise Policy Statement for England, Department for Environment, Food and Rural Affairs, March 2010.
- 4 Mechanical engineers drawings XX
- 5 Fläkt Woods, Practical guide to noise control, Fifth Edition, published by Fläkt Woods Limited
- 6 CadnaA environmental noise modelling software, version 2024, Datakustik GmbH.
- 7 ISO 9613: Acoustics - Attenuation of sound during propagation outdoors.
- 8 Architects drawings XX
- 9 ISO 12913-1:2014 Acoustics, Soundscape, Part 1: Definition and conceptual framework
- 10 Manchester City Council, Planning and Noise Technical Guidance, 2022.
- 11 Health Technical Memorandum 08-01 Acoustics, Department of Health, 2013.

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

Appendix B Residual and background sound levels

B.1 Residual sound level time history, $L_{Aeq, 1\text{ sec}}$

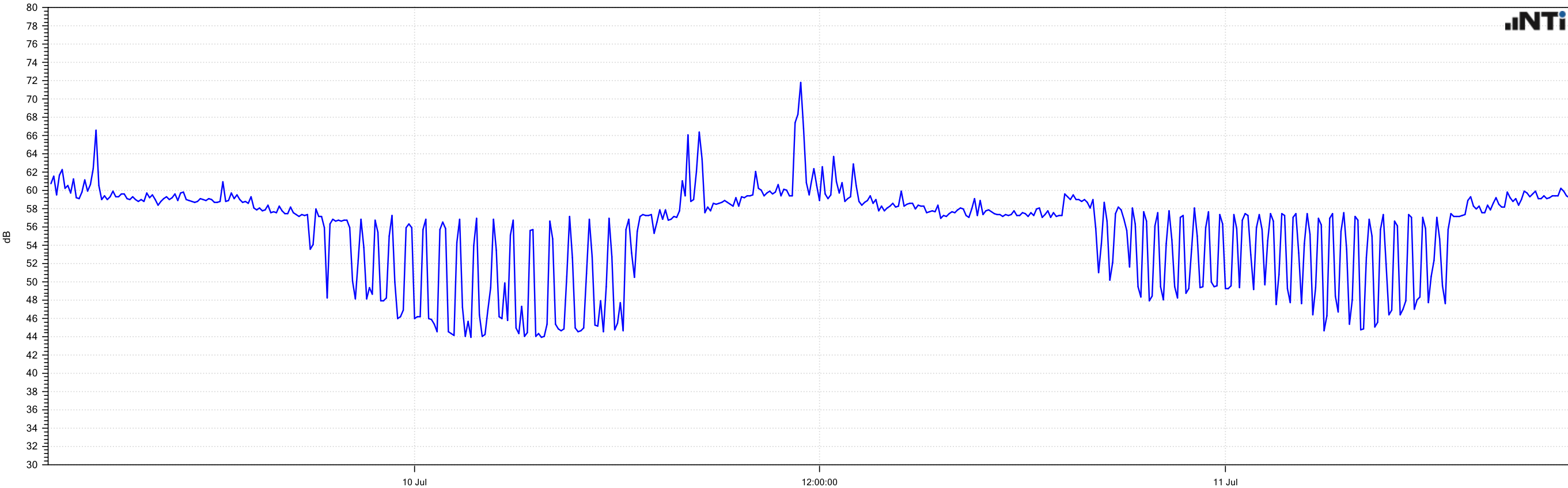


Figure 3: Residual sound level time history, $L_{Aeq, 1\text{ sec}}$ (dB) shown as blue

B.2 Analysis to determine the typical background sound level representative of the daytime period was undertaken following the guidance of BS 4142, with the results shown in Figure 4.

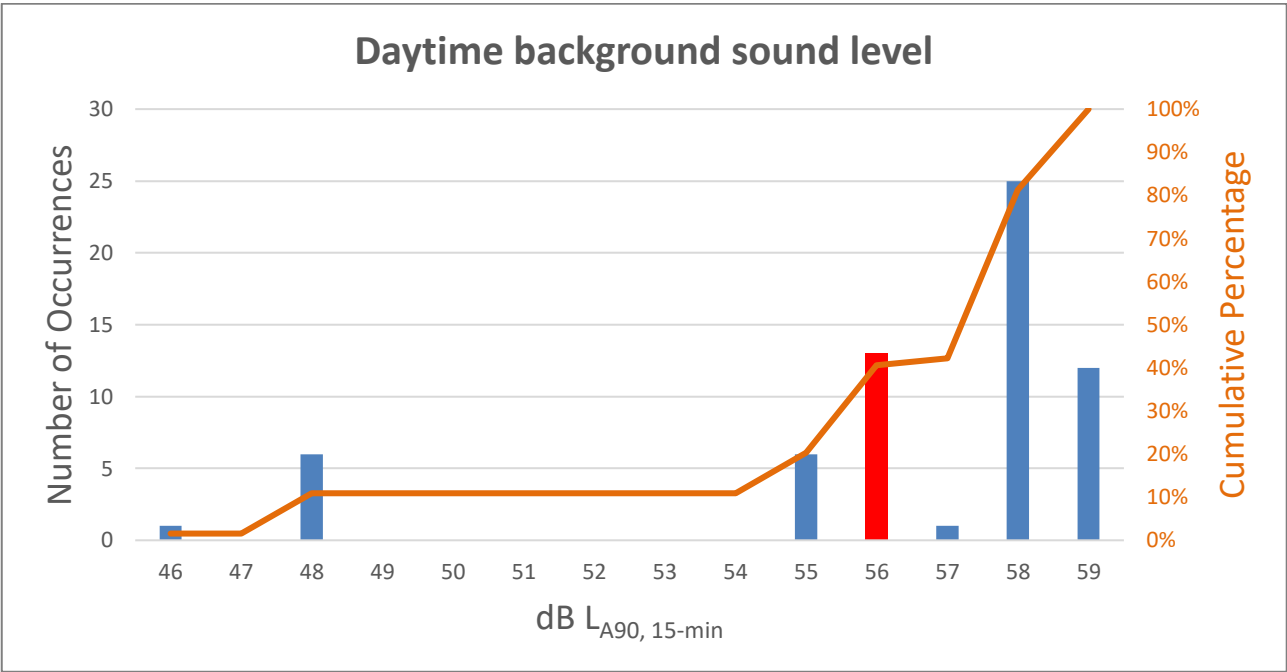


Figure 4: Analysis of daytime background levels, L_{A90, 15min}

B.3 Analysis to determine the typical background sound level representative of the night-time period was undertaken following the guidance of BS 4142, with the results shown in Figure 5.

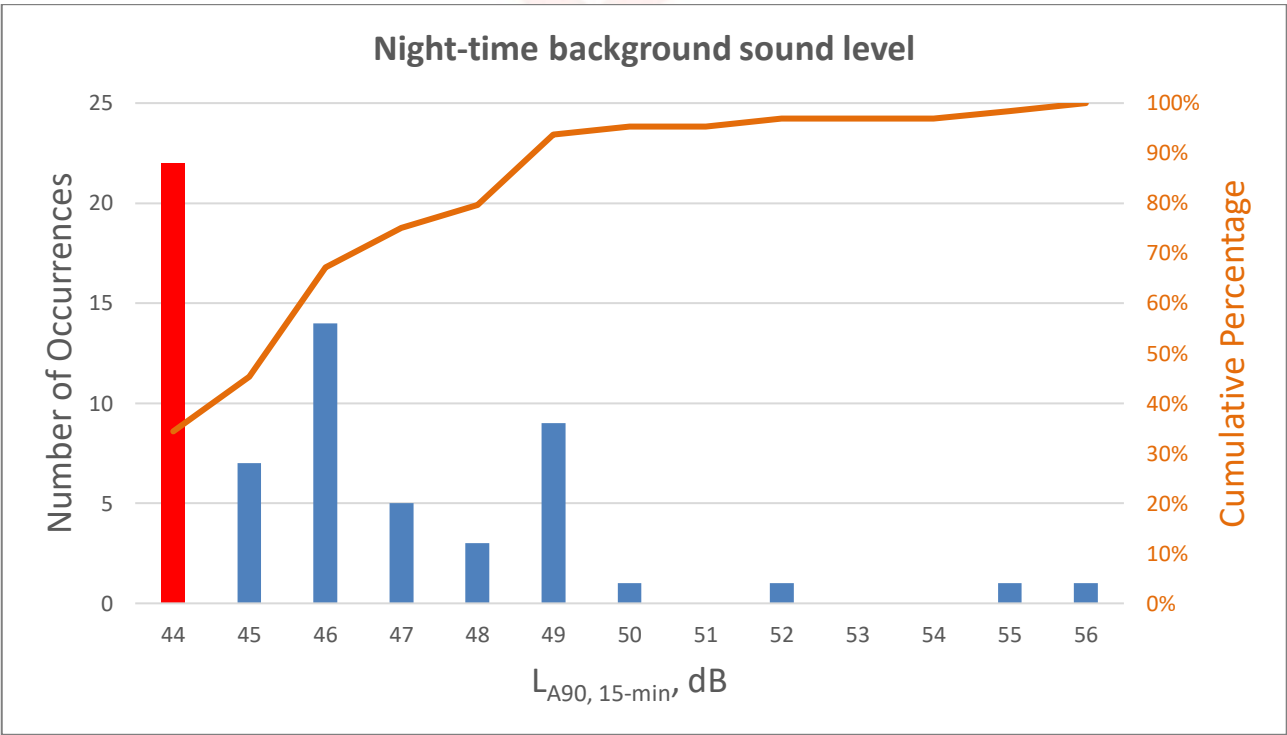


Figure 5: Analysis of night-time background levels, L_{A90, 15min}

Appendix C Plant manufacturer noise data

max.e2 06 HTM-03
Qsupply= 4430 m3/h
Qextr= 4430 m3/h

	Octave Band Center Frequency (Hz)								Sum
	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
Fresh	76.0	84.0	76.0	72.0	67.0	64.0	61.0	58.0	85.1
Supply	77.0	89.0	82.0	77.0	76.0	73.0	69.0	65.0	90.1
Room	74.0	82.0	74.0	71.0	66.0	63.0	60.0	57.0	83.1
Exhaust	75.0	87.0	79.0	76.0	75.0	72.0	68.0	63.0	88.1

Approximate sound reduction index for max.e2 panels

	18.0	18.0	23.0	28.0	30.0	29.0	32.0	36.0	
Surroundings	59.0	71.0	59.0	49.0	46.0	44.0	37.0	29.0	71.1

Sound Pressure (@ 1m)

	48.0	60.0	48.0	38.0	35.0	33.0	26.0	18.0	60.1
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Resulting with dB(A) filter @ 1m

	Octave Band Center Frequency (Hz)								dB(A)
	62.5	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
	22.8	28.4	30.4	30.3	28.5	24.7	17.0	9.4	36.1

Figure 6: Noise data for AHU 1 and 2

max.e2 09 HTM-03
Qsupply= 5220 m3/h
Qextr= 5220 m3/h

	Octave Band Center Frequency (Hz)								Sum
	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
Fresh	67.0	79.0	71.0	69.0	66.0	63.0	60.0	57.0	80.5
Supply	70.0	84.0	76.0	74.0	75.0	72.0	68.0	63.0	85.5
Room	66.0	78.0	70.0	68.0	65.0	62.0	59.0	56.0	79.5
Exhaust	69.0	83.0	75.0	73.0	74.0	71.0	67.0	63.0	84.8

Approximate sound reduction index for max.e2 panels

	18.0	18.0	23.0	28.0	30.0	29.0	32.0	36.0	
Surroundings	52.0	66.0	53.0	46.0	45.0	43.0	36.0	27.0	66.5

Sound Pressure (@ 1m)

	41.0	55.0	42.0	35.0	34.0	32.0	25.0	16.0	55.5
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Resulting with dB(A) filter @ 1m

	Octave Band Center Frequency (Hz)								dB(A)
	62.5	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
	22.8	28.4	30.4	30.3	28.5	24.7	17.0	9.4	36.1

Figure 7: Noise data for AHU 3

DAIKIN					SkyAir Alpha-series	
FAA-B / RZAG-N						
Indoor Units			Single Phase			
			FAA71B	FAA100B		
Capacity	UK Total Cooling	kW	7.76	10.85		
	UK Sensible Cooling	kW	5.32	7.44		
	Nominal Cooling	kW	6.8	9.5		
	Nominal Heating	kW	7.5	10.8		
Seasonal Efficiency (EN14825) COOLING	Energy Label		A++	A++		
	Pdesign	kW	6.8	9.5		
	SEER		6.58	6.42		
	Annual Energy Consumption	kWh	362	518		
Seasonal Efficiency (EN14825) HEATING	Energy Label		A++	A++		
	Pdesign	kW	4.7	7.8		
	SCOP		4.2	4.01		
	Annual Energy Consumption	kWh	1567	2723		
Air Flow Rate (Cooling)	High / Med / Low	m³/sec	0.270 / 0.223 / 0.202	0.433 / 0.383 / 0.317		
Dimensions	Height	mm	290	340		
	Width	mm	1050	1200		
	Depth	mm	269	262		
Weight		kg	14	18		
Sound Pressure (Cooling)	High / Med / Low	dBA	45 / 42 / 40	49 / 45 / 41		
Sound Pressure (Heating)	High / Med / Low	dBA	45 / 42 / 40	49 / 45 / 41		
Sound Power (Cooling)		dBA	61	65		
Outdoor Units			RZAG71NV1	RZAG100NV1		
Dimensions	Height x Width x Depth	mm	870 x 1100 x 460	870 x 1100 x 460		
Weight		kg	81	85		
Electrical Details	Power Supply		1ph	1ph		
	Maximum Input Current (MCA) A		17.5	21.3		
	Max Fuse Size	A	20	32		
Interconnection Wiring	Core / Cable Size		3+E / 1.5	3+E / 1.5		
Piping Connections	Liquid / Gas	inches (mm)	3/8 (9.5) / 5/8 (15.9)	3/8 (9.5) / 5/8 (15.9)		
Pipework	Maximum Length	m	55	85		
	Maximum Vertical Rise	m	30	30		
	Precharged to	m	40	40		
	Additional charge	g/m	35	35		
	Holding charge	kg	3.2	3.2		
Sound Pressure (Cooling)	Nom / Night Quiet	dBA	46 / 44	47 / 45		
Sound Pressure (Heating)	Nom / Night Quiet	dBA	48 / 44	50 / 45		
Sound Power (Cooling)		dBA	64	66		
Operating Range (Cooling)	Min / Max	°CDB	-20 / 52	-20 / 52		
Operating Range (Heating)	Min / Max	°CWB	-20 / 18	-20 / 18		
Air Flow Rate (Cooling)	Nominal	m³/sec	1.133	1.117		

Figure 8: Noise data for condensers

Appendix D AHU noise source levels

D.1 The AHUs are located internally within a plant room on the first floor. The sound power level of the air intakes and exhaust grilles on the exterior of the building was calculated based on the mechanical engineer's ventilation layout drawing. The calculations are summarised in the tables below.

Duct element	Type	Width /dia (mm)	Height (mm)	Qty/ Length (m)	Single-octave band centre frequency (Hz) In-duct attenuator insertion losses (dB)							
					63	125	250	500	1k	2k	4k	8k
In-duct L _w					76	84	76	72	67	64	61	58
Duct Loss	Rectangular	1000	450	15	-22.5	-15.0	-7.5	-4.5	-4.5	-4.5	-4.5	-4.5
Bend Loss Unlined	Square	950		1	-1.0	-5.0	-8.0	-4.0	-3.0	-3.0	-3.0	-3.0
Silencer	1.2m 50% FA			1	-2.0	-6.0	-11.0	-20.0	-23.0	-19.0	-12.0	-9.0
End Reflection					-0.7	-0.2	-0.1	0	0	0	0	0
Total duct losses					-26	-26	-27	-29	-31	-27	-20	-17
L _w at grille					50	58	49	44	37	38	42	42
L _w at grille (dBA)					49							

Table 7: AHU 01 intake grille

Duct element	Type	Width /dia (mm)	Height (mm)	Qty/ Length (m)	Single-octave band centre frequency (Hz) In-duct attenuator insertion losses (dB)							
					63	125	250	500	1k	2k	4k	8k
In-duct L _w					76	84	76	72	67	64	61	58
Duct Loss	Rectangular	1000	450	9.3	-14.0	-9.3	-4.7	-2.8	-2.8	-2.8	-2.8	-2.8
Bend Loss Unlined	Square	950		1	-1.0	-5.0	-8.0	-4.0	-3.0	-3.0	-3.0	-3.0
Silencer	1.2m 50% FA			1	-2.0	-6.0	-11.0	-20.0	-23.0	-19.0	-12.0	-9.0
End Reflection					-0.7	-0.2	-0.1	0	0	0	0	0
Total duct losses					-18	-21	-24	-27	-29	-25	-18	-15
L _w at grille					58	64	52	45	38	39	43	43
L _w at grille (dBA)					52							

Table 8: AHU 02 intake grille

Duct element	Type	Width /dia (mm)	Height (mm)	Qty/ Length (m)	Single-octave band centre frequency (Hz) In-duct attenuator insertion losses (dB)							
					63	125	250	500	1k	2k	4k	8k
In-duct L _w					67	79	71	69	66	63	60	57
Duct Loss	Rectangular	1000	450	14.8	-22.2	-14.8	-7.4	-4.4	-4.4	-4.4	-4.4	-4.4
Bend Loss Unlined	Square	950		3	-3.0	-15.0	-24.0	-12.0	-9.0	-9.0	-9.0	-9.0
Silencer	1.2m 50% FA			1	-2.0	-6.0	-11.0	-20.0	-23.0	-19.0	-12.0	-9.0
End Reflection					-0.7	-0.2	-0.1	0	0	0	0	0
Total duct losses					-28	-36	-43	-36	-36	-32	-25	-22
L _w at grille					39	43	29	33	30	31	35	35
L _w at grille (dBA)					40							

Table 9: AHU 03 intake grille

Duct element	Type	Width /dia (mm)	Height (mm)	Qty/ Length (m)	Single-octave band centre frequency (Hz) In-duct attenuator insertion losses (dB)							
					63	125	250	500	1k	2k	4k	8k
In-duct L _w					75	87	79	76	75	72	68	63
Duct Loss	Rectangular	1000	450	9.7	-14.6	-9.7	-4.9	-2.9	-2.9	-2.9	-2.9	-2.9
Bend Loss Unlined	Square	950		2	-2.0	-10.0	-16.0	-8.0	-6.0	-6.0	-6.0	-6.0
Silencer	1.2m 50% FA			1	-2.0	-6.0	-11.0	-20.0	-23.0	-19.0	-12.0	-9.0
End Reflection					-0.7	-0.2	-0.1	0	0	0	0	0
Total duct losses					-19	-26	-32	-31	-32	-28	-21	-18
L _w at grille					56	61	47	45	43	44	47	45
L _w at grille (dBA)					53							

Table 10: AHU 01 exhaust grille

Duct element	Type	Width /dia (mm)	Height (mm)	Qty/ Length (m)	Single-octave band centre frequency (Hz) In-duct attenuator insertion losses (dB)							
					63	125	250	500	1k	2k	4k	8k
In-duct L _w					75	87	79	76	75	72	68	63
Duct Loss	Rectangular	1000	450	10.6	-15.9	-10.6	-5.3	-3.2	-3.2	-3.2	-3.2	-3.2
Bend Loss Unlined	Square	950		2	-2.0	-10.0	-16.0	-8.0	-6.0	-6.0	-6.0	-6.0
Silencer	1.2m 50% FA			1	-2.0	-6.0	-11.0	-20.0	-23.0	-19.0	-12.0	-9.0
End Reflection					-0.7	-0.2	-0.1	0	0	0	0	0
Total duct losses					-21	-27	-32	-31	-32	-28	-21	-18
L _w at grille					54	60	47	45	43	44	47	45
L _w at grille (dBA)					53							

Table 11: AHU 02 exhaust grille

Duct element	Type	Width /dia (mm)	Height (mm)	Qty/ Length (m)	Single-octave band centre frequency (Hz) In-duct attenuator insertion losses (dB)							
					63	125	250	500	1k	2k	4k	8k
In-duct L _w					69	83	75	73	74	71	67	63
Duct Loss	Rectangular	1000	450	27.7	-41.6	-27.7	-13.9	-8.3	-8.3	-8.3	-8.3	-8.3
Bend Loss Unlined	Square	950		6	-6.0	-30.0	-48.0	-24.0	-18.0	-18.0	-18.0	-18.0
Silencer	1.2m 50% FA			1	-2.0	-6.0	-11.0	-20.0	-23.0	-19.0	-12.0	-9.0
End Reflection					-0.7	-0.2	-0.1	0	0	0	0	0
Total duct losses					-50	-64	-73	-52	-49	-45	-38	-35
L _w at grille					19	19	2	21	25	26	29	28
L _w at grille (dBA)					33							

Table 12: AHU 03 exhaust grille

Appendix E Noise transmission and propagation

E.1 Noise transmission and propagation outdoors was calculated according to ISO 9613. The calculation results are summarised in the tables below

Plant unit	Source L _w , dBA	Distance, m	Directivity D _c , dB	Distance attenuation A _{div} , dB	L _p at receptor, dBA	Overall L _p at receptor, dBA
AHU 01 intake	49	9.5	3	31	21	41
AHU 02 intake	52	9.5	3	31	24	
AHU 03 intake	40	9.5	3	31	12	
AHU 01 exhaust	53	24	6	39	20	
AHU 02 exhaust	53	24	6	39	20	
AHU 03 exhaust	33	24	6	39	0	
Condenser 1	66	17	6	36	36	
Condenser 2	66	17	6	36	36	
Condenser 3	66	17	6	36	36	

Table 13: Calculated plant noise level at nearest hospital window to east

Plant unit	Source L _w , dBA	Distance, m	Directivity D _c , dB	Distance attenuation A _{div} , dB	L _p at receptor, dBA	Overall L _p at receptor, dBA
AHU 01 intake	Completely screened					43
AHU 02 intake	Completely screened					
AHU 03 intake	Completely screened					
AHU 01 exhaust	53	7	6	28	31	
AHU 02 exhaust	53	7	6	28	31	
AHU 03 exhaust	33	7	6	28	11	
Condenser 1	66	15	6	35	37	
Condenser 2	66	15	6	35	37	
Condenser 3	66	15	6	35	37	

Table 14: Calculated plant noise level at nearest hospital window to west

Plant unit	Source L _w , dBA	Distance, m	Directivity D _c , dB	Distance attenuation A _{div} , dB	L _p at receptor, dBA	Overall L _p at receptor, dBA
AHU 01 intake	49	18	3	36	16	42
AHU 02 intake	52	18	3	36	19	
AHU 03 intake	40	18	3	36	7	
AHU 01 exhaust	53	15	6	35	24	
AHU 02 exhaust	53	15	6	35	24	
AHU 03 exhaust	33	15	6	35	4	
Condenser 1	66	15	6	35	37	
Condenser 2	66	15	6	35	37	
Condenser 3	66	15	6	35	37	

Table 15: Calculated plant noise level at nearest hospital window to north

Plant unit	Source L _w , dBA	Distance, m	Directivity D _c , dB	Distance attenuation A _{div} , dB	L _p at receptor, dBA	Overall L _p at receptor, dBA
AHU 01 intake	49	200	3	57	0	20
AHU 02 intake	52	200	3	57	0	
AHU 03 intake	40	200	3	57	0	
AHU 01 exhaust	53	200	6	57	2	
AHU 02 exhaust	53	200	6	57	2	
AHU 03 exhaust	33	200	6	57	0	
Condenser 1	66	200	6	57	15	
Condenser 2	66	200	6	57	15	
Condenser 3	66	200	6	57	15	

Table 16: Calculated plant noise level at nearest off-site receptor

Appendix F Professional qualifications and competence

- F.1 All Apex Acoustics consultants work under the close supervision of a member who holds qualification in acoustics and is a member of the IOA.
- F.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>
- F.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 member's competency.
- F.4 This report has been completed by an appropriately qualified and experienced acoustic consultant.