

**ROYAL BERKSHIRE HOSPITAL, READING:
ERF PROJECT – PLANT NOISE ASSESSMENT**

**On behalf of:
Gray Baynes + Shew**

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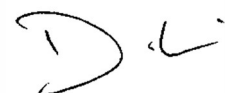
Report prepared by:
Hepworth Acoustics Ltd
1st Floor Aztec Centre
Aztec West
Almondsbury
Bristol
BS32 4TD

On behalf of:
Gray Baynes + Shew

Report prepared by:
Graham Bowland BSc MIOA – Technical Director



Report checked by:
Donald Quinn BSc FIOA – Managing Director



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1.0 INTRODUCTION

- 1.1 Hepworth Acoustics Ltd was commissioned by Gray Baynes + Shew to carry out a noise impact assessment in connection with a planning application relating to new building services plant at a proposed new two-storey building at Royal Berkshire Hospital (RBH).
- 1.2 The site of the proposed new building is to the south of the main RBH campus, towards the centre of the north boundary of the Addington Road Car Park.
- 1.3 The site is currently occupied by an existing temporary modular building which is to be removed.
- 1.4 The proposed new plant is to be located within a ground floor level compound, adjoining the east elevation of the building. The compound will be enclosed by way of 4m high solid and imperforate outer screen walls, providing acoustic protection, but will be open to above.
- 1.5 It is understood that precise plant designs and selections are yet to be finalised, although the necessary provisions have been determined on an outline basis. This will include air-handling plant, likely to be in the form of a single Air-Handling Unit (AHU) per floor level, hence potentially two systems. We understand this may instead be two slightly smaller units, with additional considerably smaller supplementary units for discrete areas, albeit amounting to the same overall capacity. The former configuration is considered herein.
- 1.6 There will be a provision for atmosphere-side attenuators to be incorporated into each AHU system, as necessary.
- 1.7 Potentially up to four chiller units will also be incorporated.
- 1.8 Indicative noise emissions data for the equipment has been provided for the plant, as set out later in this report.
- 1.9 It is understood that the proposed plant will have the potential to operate 24-hours a day.
- 1.10 The nearest residential properties to the proposed plant are those directly to the east on Craven Road at a minimum distance of ~60m laterally from the proposed plant compound, and those directly to the south at Addington Road at a minimum distance of ~55 laterally from the proposed plant compound.

- 1.11 The site location and nearest residential premises are identified in Figure 1.
- 1.12 The various noise units and indices referred to in this assessment are described in Appendix I. All noise levels mentioned in the text have been rounded to the nearest decibel, as fractions of decibels are imperceptible.
- 1.13 The primary scope of this report is to consider noise from the proposed new plant at residential locations, for planning purposes. Nonetheless, some further guidance is included with regards to control of noise and vibration to internal Hospital areas.

2.0 NOISE SURVEY

- 2.1 A baseline noise survey was undertaken at the site in the early night-time period from 2343hrs on Tuesday 31st January 2023 until 0129hrs of the following morning to determine prevailing ambient/background noise levels at the nearest noise sensitive properties to the proposed plant.
- 2.2 Noise measurements were undertaken in 15-minute samples in alternation between two on-street locations at Addington Road and Craven Road respectively, as identified in Figure 2.
- 2.3 The measured noise levels are set out in Table 1.

Table 1 : Measured Noise Levels

Time	Noise Level (dB)			
	$L_{Aeq,15min}$		$L_{A90,15min}$	
	Location 1	Location 2	Location 1	Location 2
2347 hrs	51	-	45	-
0005 hrs	-	53	-	48
0022 hrs	49	-	44	-
0039 hrs	-	50	-	48
0057 hrs	47	-	44	-
0114 hrs	-	49	-	48

- 2.4 The measured background noise levels were generally due to existing hospital building services plant noise emissions and also occasional passing vehicles.
- 2.5 The noise measurements were undertaken using a Norsonic 140 Type 1 Integrating Sound Level Meter (serial no. 31617). Field calibration checks were carried out using a Norsonic 1251 class 1 acoustical calibrator (serial no. 20804) before and after the survey and no variation in the calibration level was observed.
- 2.6 The measurement microphone was fitted with a windshield and mounted at 1.5m above local ground in free-field conditions.
- 2.7 The weather during the survey was dry and calm, with windspeeds typically below 3m/s.

3.0 ACOUSTIC CRITERIA

- 3.1 British Standard 4142: 2014 +A1:2019 'Methods for rating and assessing industrial and commercial sound' provides methods for rating and assessing sound of an industrial nature from industrial or commercial premises.
- 3.2 This requires the sound from a specific source (in L_{Aeq}) to be compared with the existing background sound level (L_{A90}) outside residential locations. The standard also puts weight on the importance of the context in which the sound will occur.
- 3.3 The 'rating' level is based on the 'specific' L_{Aeq} sound level attributable to the operation with an 'acoustic feature' penalty added for any sound sources which give rise to tonal, impulsive, intermittent, or other characteristics readily distinctive against the residual acoustic environment.
- 3.4 BS 4142 stipulates that impacts should be assessed over a reference time interval of 1-hour during the daytime (0700-2300hrs) and 15-minutes during the night-time (2300-0700hrs).
- 3.5 An initial estimate of the impact of the operation is determined by subtracting the background level from the 'rating' level. BS 4142 states that:
- A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context
 - A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context
 - 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.
- 3.6 Regarding background sound levels, BS 4142 requires that *"values are reliable and suitably represent the particular circumstances and periods of interest... the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods"*. It is also stated that *"diurnal patterns can have a major influence on background sound levels and, for example, the middle of the night can be distinctly different (and potentially of lesser importance) compared to the start or end of the night-time period for sleep purposes"*.

- 3.7 We note from previous similar assessments undertaken locally, that Reading Borough Council typically seek for the rating sound level of new plant to be 10dB below the pre-existing background sound level, $L_{A90,T}$ at a point 1 metre externally to nearby residences.
- 3.8 The foregoing demonstrates that this is a particularly onerous stipulation, following the provisions of BS 4142. Nonetheless, for the purposes of this assessment, based on this, and the findings of the baseline noise survey described here, the following noise rating limits are determined:
- 34dB $dB L_{A,r}$ at 1m from residences at Addington Road
 - 38dB $dB L_{A,r}$ at 1m from residences at Craven Road

4.0 NOISE ASSESSMENT

- 4.1 As discussed, at the time of undertaking this assessment, plant designs and selections have not been finalised, and therefore it is not possible to consider precise noise emissions for the proposed plant.
- 4.2 However, some indicative plant data, representative of the type and size that will be appropriate for the project, has been provided to us, as set out in Table 2.

Table 2 : Indicative Plant Noise Emissions Data

Component		Sound Power Level dB / Octave Band Centre Frequency Hz							
		63	125	250	500	1k	2k	4k	8k
AHU	Intake	78	74	74	70	61	61	57	58
	Exhaust	73	86	83	83	82	81	78	75
	Casing	75	69	64	53	47	48	44	37
Chiller		56	61	66	67	70	74	65	54

- 4.3 Based on the data set out in Table 2, initial calculations have been undertaken of expected noise levels at existing residences at Addington Road and Craven Road.
- 4.4 The calculations have been carried out taking account of distance attenuation, and also barrier attenuation for the proposed 4m compound walls. In the absence of specific layouts of the proposed plant and ducting arrangements, this has been based on a reference source location for each case in the centre of the plant compound, with an acoustic centre at a height of 1.5m above ground. Receiver heights have been taken as 7.5m at Craven Road, and as 9m at Addington Road, to account for the 3-storey residences in both cases, and an additional increase in ground level at the latter.
- 4.5 It has been assumed in all cases that the noisiest sides of each component will be oriented towards the residences, even though this will not practically be the case.
- 4.6 In the absence of specific information regarding duct sizes, end reflection losses at duct terminations to atmosphere have been ignored. As such, in reality some additional losses in low frequency noise are to be expected, although this may be minimal if duct cross-sectional areas are relatively large.

- 4.7 As discussed, there will be a provision for atmosphere-side attenuators to be incorporated into each system. However, in the first instance, these have been ignored for in the initial calculations. This allows indicative attenuator insertion losses to be determined.
- 4.8 The initial predicted noise levels, excluding atmosphere-side attenuators, are set out in Table 3, alongside the target rating sound level limits determined above.

Table 3 : Indicative Predicted Plant Noise Emissions

Component		Indicative Predicted Plant Noise Emissions			
		Addington Road		Craven Road	
		Per Unit	Two Units	One Unit	Two Units
AHU	Intake	24	27	17	20
	Exhaust	39	42	31	34
	Casing	13	16	8	11
Chiller		27	30	18	21
TOTAL (2 AHUS + 2 Chillers)		42		34	
Noise limit		34		38	
Exceedance		+8		-	

- 4.9 It is noted that that plant is not expected to contain any distinguishable acoustic features and hence the predicted specific sound levels may be taken as the rating sound levels in this case. However, this should be confirmed on making final selections.
- 4.10 Based on the above assessment, it is shown that noise levels are expected to fall within appropriate noise limits at residences to the east at Craven Road, pending final plant designs and selections.
- 4.11 At residences to the south at Addington Road, the initial indicative assessment indicates a potential 8dB exceedance of the applicable target rating sound level limit, again pending final plant designs and selections.
- 4.12 It can also be seen that this is almost entirely due to the predicted noise from the AHU exhaust terminations. It is therefore recommended that suitable provision is maintained within the scheme for atmosphere-side attenuators to the AHU exhausts, providing insertion losses, indicatively (i.e. based on this initial assessment) as set out in Table 4.

Table 4 : Recommended Attenuator Insertion Losses

Component	Sound Power Level							
	63Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz
Inlet	2	4	9	15	17	14	10	8

- 4.13 It is also strongly recommended that provision is made for the walls of the plant compound to be formed with an acoustically absorbent internal facing. Typically, this will be achieved by way of mineral fibre retained behind perforated steel sheeting. Suitable proprietary options are available. This is likely to be necessary to control reflective build-up of noise within the plant compound.
- 4.14 The plant compound walls should also be formed of solid and imperforate construction, having a superficial mass of at least 10kg/m². The compound walls should be well-sealed to all other abutting surfaces including the ground.
- 4.15 Based on the assessment set-out herein, with the recommended measures installed, it is expected that that appropriate noise limits will be achieved.
- 4.16 It is stressed that the above is an initial assessment, and it will be necessary for further calculations to be carried out on confirmation of the precise designs and selections to ensure the noise limits are not exceeded. However, the currently recommended atmosphere-side attenuators insertion losses are relatively modest, and hence there should be ample scope for additional noise mitigation should this prove necessary. Pending final designs and selections, it is recommended that provision for atmosphere-side attenuators to the fresh-air intake ducting are retained.

Comments on Noise Impact on Hospital Area

- 4.17 Further to above, albeit not a planning issue, it is recommended that consideration is given to controlling noise emissions from the proposed new plant within other hospital accommodation, both within the proposed building itself and other nearby buildings.
- 4.18 The Department of Health document Health Technical Memorandum 08-01 (HTM 08) stipulates internal noise levels from external noise sources. This is set out in absolute terms, rather than in terms relative to existing noise levels.

- 4.19 HTM 08-01 sets out suitable internal noise design criteria in rooms in healthcare buildings in terms of dB $L_{Aeq,T}$ noise levels, for the consideration of general intrusive external noise. However, these criteria do not include hospital plant noise, which instead should be assessment using a separate set of HTM 08 criteria based on the noise rating (NR) system. This applies to airborne, structure-borne and ductborne noise transfer into areas of the building in/on which the plant is to be installed.
- 4.20 The criteria applicable to internal areas are set out in Table 5.

Table 5 : HTM 08 Criteria for Internal Noise from Mechanical and Electrical Services

Space	M+E Noise Limit
Ward areas, Sleeping areas, Large meeting rooms (>35m ²)	NR30
Recovery rooms, Small office-type spaces, Small meeting rooms (≤35m ²)	NR35
Open clinical areas, Circulation spaces, Public areas, Personal hygiene (ensuite), Small food-preparation areas, Operating theatres, Laboratories, Utility rooms	NR40
Personal hygiene (general access)	NR45
Large food-preparation areas, Laminar-flow theatres	NR50

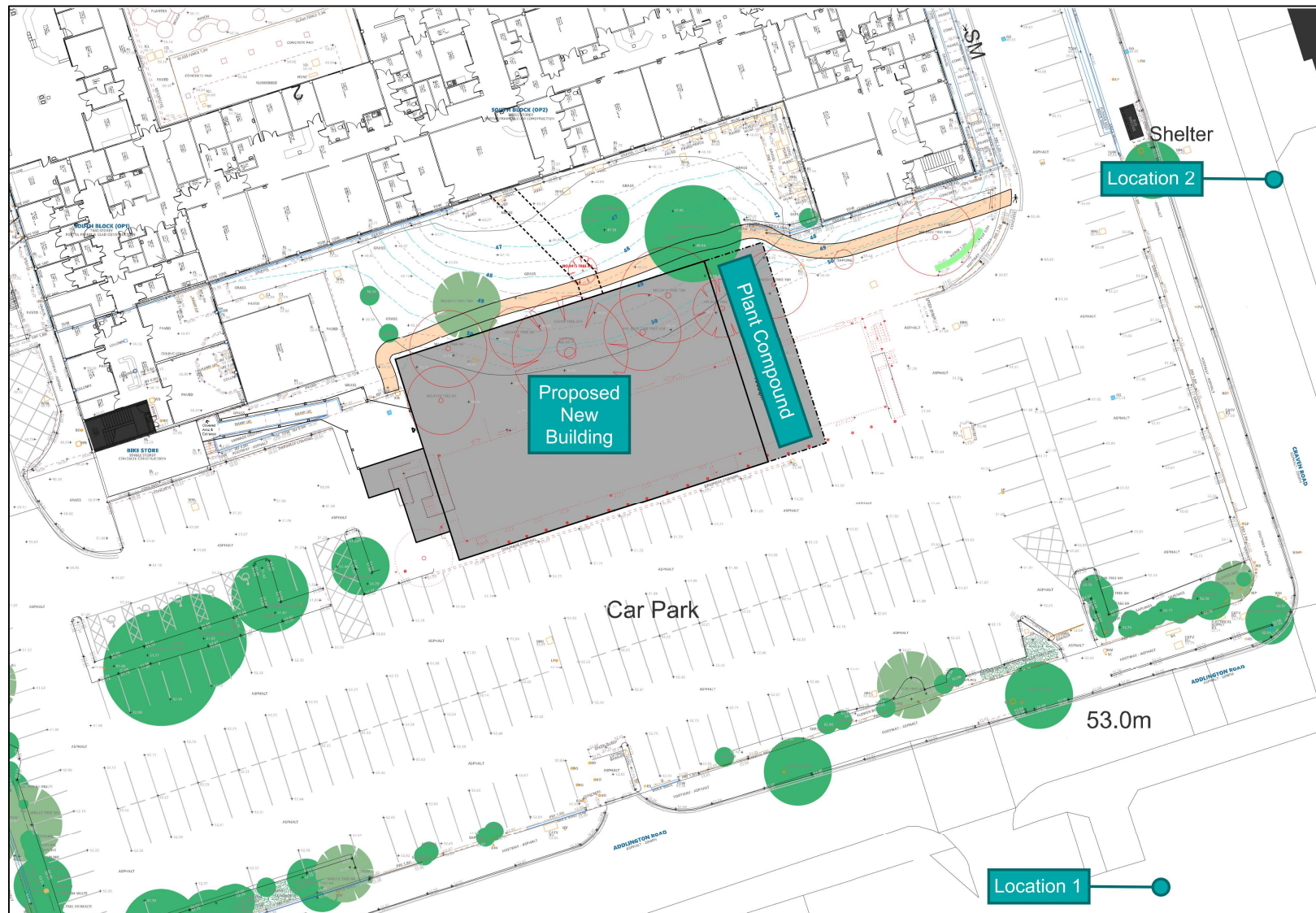
- 4.21 The implications of the above guidelines upon the proposed new plant will be dependent upon a number of factors. This will include factors relating to the noise emissions from the plant itself, such as the relative location and orientation of the plant with respect to the various nearby hospital areas. However, it may also be necessary to consider existing M+E noise levels inside individual space, so as to avoid adding to this such that the cumulative level exceeds the applicable criterion, and also the sound insulation of the building envelope of the space, and/or the reliance of the use of the space on openable windows for ventilation of the space.
- 4.22 In terms of spaces within the proposed building itself, this will require consideration of room-side attenuators to control noise at grilles, as well as potential requirements to upgrade ceilings within sensitive areas to control break-out noise via duct walls and/or direct noise transfer via the roof.
- 4.23 It is also recommended that all plant is mounted using suitable vibration isolators to reduce the potential for structure-borne noise to internal areas of the building.

- 4.24 Determination of noise impact on hospital areas, and consequent specific implications, is beyond the scope of this assessment. However, in terms of other nearby buildings, it is possible that further attenuation of plant noise will be needed (compared to that required to adequately control noise at residences), potentially via incorporation of the acoustic louvre acoustic louvred screen around the new plant area, for which provision has been made, and/or increased atmosphere-side attenuators to the intake and exhaust ducts.

5.0 SUMMARY AND CONCLUSION

- 5.1 The potential noise impact associated with the installation new building services plant at a proposed new two-storey building at Royal Berkshire Hospital (RBH).
- 5.2 An appropriate environmental noise criterion for the new plant has been recommended for planning purposes based on a very robust interpretation of the guidance of set out in British Standard 4142: 2014 +A1:2019, as per our understanding of Local Authority preferred policy. This applies at the nearest residential premises to the proposed plant.
- 5.3 Pending finalised plant selections and noise emissions data, it has been determined that, subject to implementation of recommendation set out herein, pertaining to the provision of standard noise control apparatus, there should be no constraint to achieving the appropriate plant noise limits at the nearest residences.
- 5.4 Separately it has been discussed that additional noise and vibration control measures may be needed to ensure adequate control of noise impact inside Hospital areas.

Figure 1 : Site Plan



Appendix I: Noise Units & Indices

Sound and the decibel

A sound wave is a small fluctuation of atmospheric pressure. The human ear responds to these variations in pressure, producing the sensation of hearing. The ear can detect a very wide range of pressure variations. In order to cope with this wide range of pressure variations, a logarithmic scale is used to convert the values into manageable numbers. Although it might seem unusual to use a logarithmic scale to measure a physical phenomenon, it has been found that human hearing also responds to sound in an approximately logarithmic fashion. The dB (decibel) is the logarithmic unit used to describe sound (or noise) levels. The usual range of sound pressure levels is from 0 dB (threshold of hearing) to 120dB (threshold of pain).

Due to the logarithmic nature of decibels, when two noises of the same level are combined together, the total noise level is (under normal circumstances) 3dB(A) higher than each of the individual noise levels e.g. 60dB(A) plus 60dB(A) = 63dB(A). In terms of perceived 'loudness', a 3dB(A) variation in noise level is a relatively small (but nevertheless just noticeable) change. An increase in noise level of 10 dB(A) generally corresponds to a doubling of perceived loudness. Likewise, a reduction in noise level of 10 dB(A) generally corresponds to a halving of perceived loudness.

The ear is not equally sensitive to sound at all frequencies. It is less sensitive to sound at low and very high frequencies, compared with the frequencies in between. Therefore, when measuring a sound made up of different frequencies, it is often useful to 'weight' each frequency appropriately, so that the measurement correlates better with what a person would actually hear. This is usually achieved by using an electronic filter called the 'A' weighting, which is built into sound level meters. Noise levels measured using the 'A' weighting are denoted dB(A) or dBA.

Frequency and Hertz (Hz)

As well as the loudness of a sound, the frequency content of a sound is also very important. Frequency is a measure of the rate of fluctuation of a sound wave. The unit used is cycles per second, or hertz (Hz). Sometimes large frequency values are written as kiloHertz (kHz), where 1 kHz = 1000 Hz.

Young people with normal hearing can hear frequencies in the range 20 Hz to 20 kHz. However, the upper frequency limit gradually reduces as a person gets older.

Glossary of Terms

When a noise level is constant and does not fluctuate, it can be described adequately by measuring the dB(A) level. However, when the noise level varies with time, the measured dB(A) level will vary as well. In this case it is therefore not possible to represent the noise climate with a simple dB(A) value. In order to describe noise where the level is continuously varying, a number of other indices can be used. The indices used in this report are described below.

L_{Aeq} This is the A-weighted 'equivalent continuous noise level' which is an average of the total sound energy measured over a specified time period. In other words, L_{Aeq} is the level of a continuous noise which has the same total (A-weighted) energy as the real fluctuating noise, measured over the same time period. It is increasingly being used as the preferred parameter for all forms of environmental noise.

L_{A90} This is the A-weighted noise level exceeded for 90% of the time period. L_{A90} is used as a measure of background noise.