

Acoustic South East



Discharge of Planning Conditions 17 and 18 of AWDM/0261/26

Report by: Scott Castle BSc (Hons) CEnvH, MCIEH MIOA

Date: 31/07/2026

Project: J4236

Issue 1

Site: **Land at 8-9 Holmbush Close, Shoreham by Sea.**

Client: **Sarah Grace**

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Report by: Scott Castle BSc (Hons) CEnvH, MCIEH MIOA

Checked by: Peter Attwood BSc(Hons) MSc MCIOB MIOA

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1 Introduction and Executive Summary

Acoustic South East have been appointed to undertake an acoustic assessment to discharge a planning condition for a single new build property. Specifically, Adur and Worthing District Council consented the property under AWD/0261/26 and conditions 17 and 18 are required to be discharged.

Standards and guidance referenced for this assessment include:

- BS8233 (Sound insulation and noise reduction for buildings) 2014
- Building Regulations Approved Document O – Overheating (2021)
- Chartered Institute of Environmental Health and Institute of Acoustics *Heat Pumps, Professional Advice note*
- ProPG2017- Professional Practice Guidance on Planning & Noise

Condition 17 relates to the impact of a proposed Air Source Heat Pump and requires that this is less than 35dB $L_{Aeq,15minutes}$ at the nearest residential receptor. Condition 18 requires a soundscape assessment and subsequent scheme of mitigation measures to protect the future occupants of the property.

A sound survey was set up from 30th June 2026 to 6 July 2026 to measure the site soundscape at the location of the consented property. This showed average daytime sound pressure levels of 53dB $L_{Aeq,16 hour}$ and average night time sound pressure levels of 48dB $L_{Aeq,8 hour}$.

Rigorous calculations were undertaken to identify suitable glazing and/or ventilation to ensure noise levels were consistent with the requirements of Condition 18. The Sound Reduction Index requirements are relatively low (18dB) and are easily achieved with standard thermal double glazing and either through frame or through wall ventilation.

For condition 17, noise modelling software (IMMI) was used to consider the impact of a new Daikin external Air Source Heat Pump. This predicts an external sound pressure level of 30dB rounded at the nearest residential property to the South and is below the requirements of condition 17. The predicted external sound pressure levels from the ASHP are also 17dB below the daytime measured background sound pressure levels and 7dB below the night time measured background sound pressure levels.

Sufficient information has been presented in regard to conditions 17 and 18 in order that the local planning authority may discharge these conditions.

2 Context, Noise Criteria & Noise Assessment Methodology

2.1 Context

This reporting seeks to discharge conditions 17 and 18 of AWDM/0261/26. This is a new build property in Holmbush Close. Residential properties exist to the West, East and South of the site and farmland/Southdowns national park exists to the North of the site.

The A27 is located approximately 130m North West of the site and can be heard as continuous and anonymous sound from the consented site.

For ease of reference, the conditions are replicated as follows:

17. Prior to commencement an Air Source Heat Pump acoustic report shall be submitted to the Local Planning Authority for approval. This report shall show that the installation of the heat pump complies with the Chartered Institute of Environmental Health and Institute of Acoustic's guidance: 'Heat Pumps, Professional Advice note.' The report shall outline that the rating level from the ASHP shall not exceed 35dBLAeq15min at any noise sensitive façade of a neighbouring residential premises. If it is not practical to achieve this value and the local context supports a relaxation, then a report providing a full justification as to why such a relaxation in rating level is required, shall be submitted in writing to the Local Authority for approval.

18. Construction work shall not commence until a scheme for protecting the proposed noise sensitive development from traffic noise from the A27 has been submitted to and approved by the local planning authority. All works, which form part of the scheme, shall be completed before any part of the noise sensitive development is occupied. The scheme shall have regard to the principles contained within the ProPG: Planning & Noise - New Residential Development, 2017 and achieve the indoor ambient noise levels for dwellings specified in BS8233:2014. The scheme should be of good acoustic design, include full details of glazing, and a strategy to prevent overheating. The noise level of any ventilation units when in use should not exceed the levels specified in BS8233:2014 and all duct work should be fitted on antivibration mounts. Following approval and completion of the scheme, a test shall be undertaken to demonstrate that the attenuation measures proposed in the scheme are effective and protect the residential unit from noise.

The reporting therefore seeks to address the requirements of conditions 17 and 18 respectively.

2.2 Site Location

The consented site is detailed below in red in Figure 1.

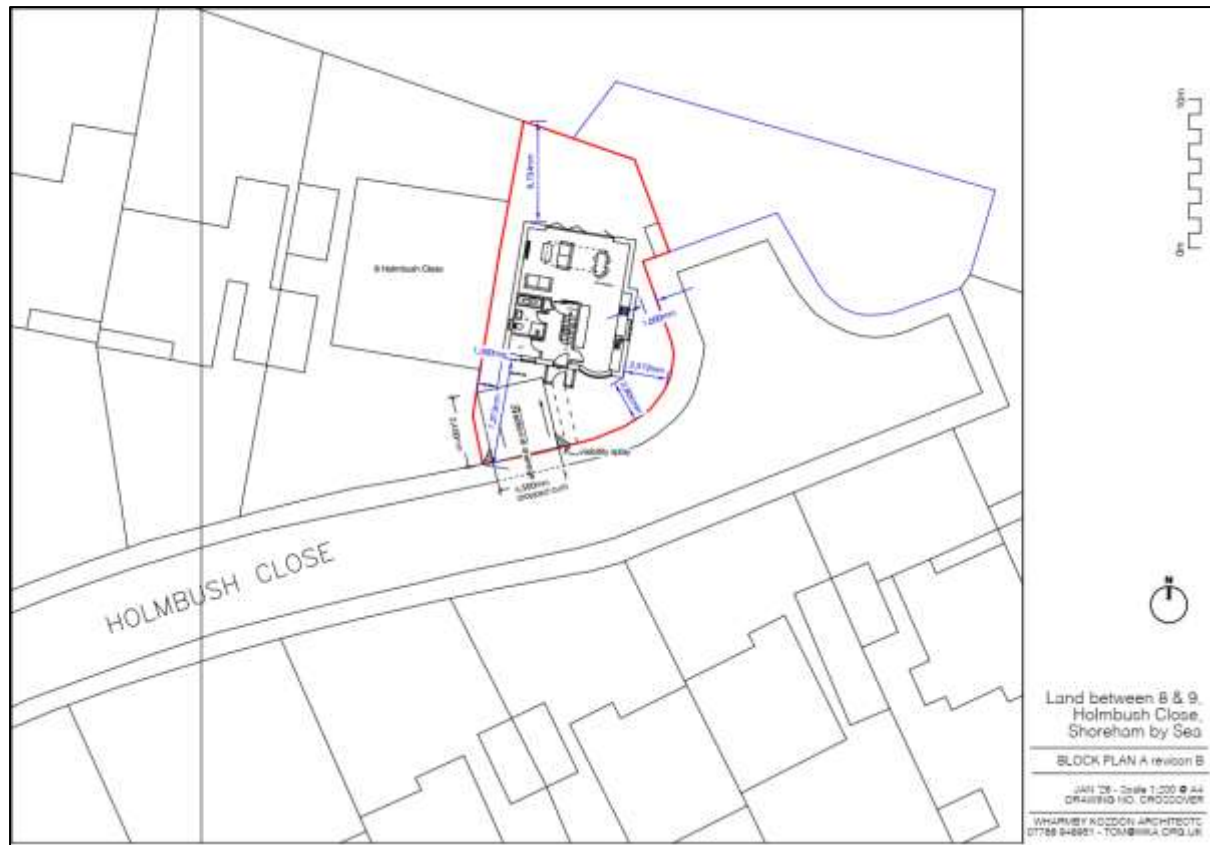


Figure 1. Site Location

2.3 Soundscape

During the site visit, the soundscape was noted to primarily consist of distant road traffic noise from the A27 and birdsong, along with intermittent construction noise from a neighbouring house. There is no line of sight to the A27.

3 Relevant Standards and Guidance

The relevant standards included within the conditions are as follows. It will not be relevant to provide policy details, as the property is already consented.

3.1 BS8233:2014 -Guidance on Sound Insulation and Noise Reduction for Buildings

Table 4 of BS8233:2014 provides the following guideline values:

Activity	Location	Time period of day	
		07:00-23:00	23:00-07:00
Resting	Living Rooms	35dB $L_{Aeq,16hour}$	-
Dining	Dining Room/Area	40dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35dB $L_{Aeq,16hour}$	30dB $L_{Aeq,8hour}$

Table 1. BS8233:2014 Criteria

It is relevant to note that Table 4 criteria in BS8233:2014 relates to continuous and anonymous sound. The observed soundscape is consistent with this being distant road traffic noise and continuous and anonymous.

3.2 The Chartered Institute of Environmental Health and Institute of Acoustics guidance: 'Heat Pumps, Professional Advice note' (2022)

The Chartered Institute of Environmental Health and Institute of Acoustics guidance: 'Heat Pumps, Professional Advice note' (2022) recognises that the MCS permitted development heat pump noise calculation alone may not be sufficient to prevent adverse impacts, as it does not fully account for some factors such as tonality, intermittency of operation and structure borne sound and vibration transmission. The CIEH recommendation is to reduce vibration transfer by using appropriate mounting, selecting appropriate heat pumps and selecting locations away from sensitive areas such as living room or bedroom windows. The guidance also recommends the noise from the installation not exceeding a level of 35dB at any noise sensitive façade of neighbouring residential premises. In certain situations, when supported by an acoustic assessment, a level of 40dB is acceptable when a 35dB level is not appropriate.

3.3 ProPG2017 - Professional Practice Guidance on Planning & Noise

Planning guidance (ProPG2017) relates to new residential development and airborne transportation noise, which includes exposure to road traffic, railway and aviation noise. Whilst ProPG, 2017 generally mirrors the requirements of BS8233:2014 and the World Health Organisation Guidelines, 1999, it goes further in setting a limit for inside bedrooms for L_{Amax} events and specifically, no more than 10 L_{Amax} events per night time period above 45dB(A).

The internal bedroom L_{Amax} values will be used in accordance with ProPG2017

3.4 Building Regulations Approved Document O - Overheating

Recently introduced Part O of the building regulation requires an assessment of whether bedroom windows can be opened at night. It is assumed that bedroom windows will be closed if either of the conditions below are met:

- Internal noise level exceeds 40dB $L_{Aeq, 8\text{hour}}$
- L_{Amax} events exceed 55dB L_{Amax} more than 10 times a night.

4 Proposed Plant and Location

The client proposes a single Air Source Heat Pump positioned along the Eastern wall of the property. This is a Daikin 5MWXM68A9 unit with a sound power level of 61dB. An extract is shown below from the manufacturers data.

Outdoor Unit				4MWXM52A9	5MWXM68A9	5MWXM90A9
Dimensions	Unit	Heightx WidthxDepth	mm	734 x 974 x 401	734 x 1028 x 408	734 x 1028 x 408
Weight	Unit		kg	60	64,5	69,5
Sound power level	Cooling	Nom.	dBA	59	61	64
	Heating	Nom.	dBA	60	*	*
Sound pressure level	Cooling	Nom.	dBA	46	48	52
	Heating	Nom.	dBA	47	49	53

Figure 2. Extract from Daikin Brochure.

5 Survey Methodology

A class 1 sound level meter was erected at the Northern element of the consented property which would be most exposed to road traffic noise. The sound level meter (Svantek 971A) allows 1-minute resolutions suitable for an assessment of daytime but importantly, also the night time soundscape (consistent with the requirements of the Planning Noise Advice Document Sussex dated November 2023). A 15-minute resolution is also capable of being measured and this will be relevant to review daytime and night time background sound pressure levels ($L_{A90,15minutes}$)

The meter was calibrated whilst present at the site set up as well as at the decommissioning to ensure that the data was capable of being relied upon. The measured data is fast, A weighted and freefield (given that it was 6m from the neighbouring wall at 8 Holmbush Close).



Figure 3. Survey Location

Survey(s) carried out by	Scott Castle BSc(Hons) Env Health, MCIEH CEnvH MIOA
Equipment Used	1 x Svantek 971A Class 1 Sound Level Meter (LT1)
Equipment Used	Castle Acoustic Calibrator – Serial No. 041173
Location	WhatThreeWords – LT1-desire.veal.lasts. 2m above ground level
Duration	30 th June to 6 th July 2026

Table 2. Survey Data

6 Measured Data

6.1 $L_{Aeq,T}$

The measured data from the survey position to inform the Sound Reduction Index (SRI) is presented below in Figure 4.

LT1 - Holmbush Close									
Day	Date	$L_{Aeq\ 16/8Hr}$		11th L_{Amax}		Sound Reduction Index (SRI) Required			
		Day	Night	1 min	2min	Day 16Hr	Night 8 Hr	$L_{Amax, 1min}$	$L_{Amax, 2min}$
Tue	30/06		48.8	65.5	63.9		19	20	19
Wed	01/07	53.0	46.2	60.1	60.1	18	16	15	15
Thu	02/07	55.5	51.0	65.0	64.9	21	21	20	20
Fri	03/07	51.8	46.9	62.7	62.0	17	17	18	17
Sat	04/07	53.7	49.0	63.7	63.6	19	19	19	19
Sun	05/07	50.5	46.8	63	63	16	17	18	18
Mon	06/07	49.4	48.1	63	63	14	18	18	18
AVERAGE:		53	48	63	63	18	18	18	18

Figure 4. Measured Survey Data (Freefield)

6.2 L_{A90} Measured Background Sound Pressure Level

Clearly it is not appropriate to average an L_{A90} value, as these are already a percentile. Therefore, as opposed to an arithmetic average above in Figure 4, the L_{A90} values are reviewed in terms of modal and most frequently occurring data. This is presented for both the daytime and night time period.

6.2.1 Daytime (07:00-23:00 Hours)

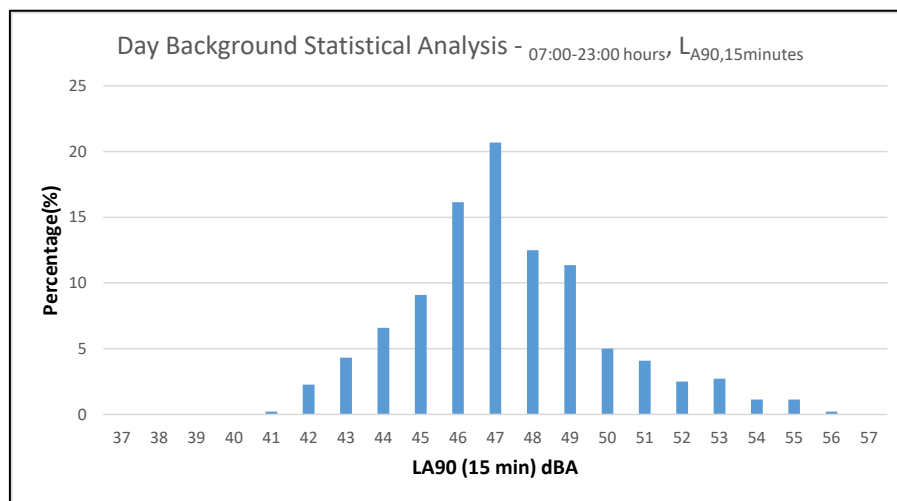


Figure 5. Measured $L_{A90,15minutes}$ - Daytime

6.2.2 Night Time (23:00-07:00 hours)

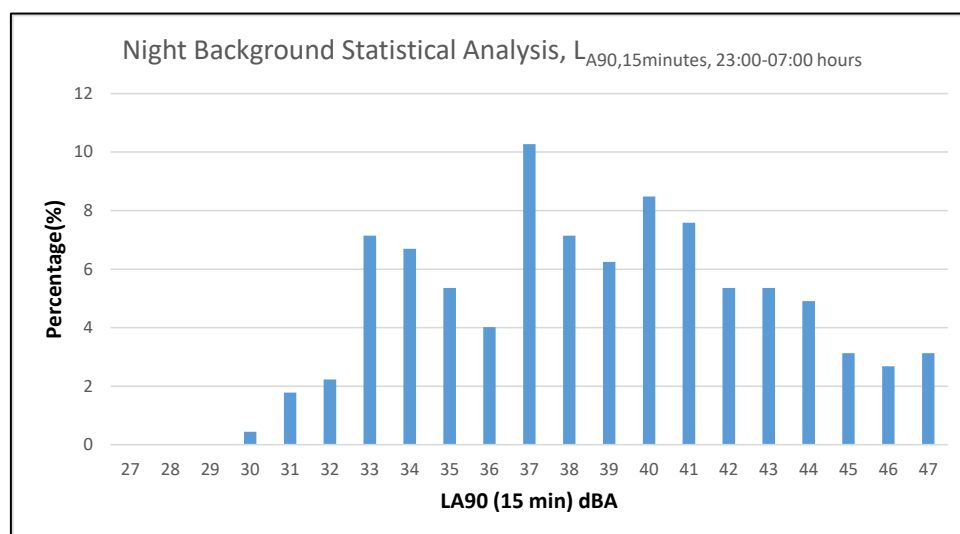


Figure 6. Measured $L_{A90,15\text{minutes}}$ – Night Time

The measured background sound pressure levels for the daytime and nighttime periods are 47dB $L_{A90,16\text{ hour}}$ and 37dB $L_{A90\ 8\text{ hour}}$ respectively.

7 Discussion (Condition 18)

7.1 Conditions and Wording

Whilst condition 18 references that the “scheme submitted shall include good acoustic design, as per ProPG2017”, this is difficult to achieve as the local planning authority have already consented the positioning of the building, its orientation, the floorplan plan layout and the window sizes.

7.2 Sound Reduction Index (SRI)

From Figure 3 above, it is noted that the sound reduction index is 18dB. To place this in context, Table B2 from the AVOG (2020) has been replicated below. This shows that a level difference of up to 22dB is capable of being achieved with typical windows and vents.

Ventilation System from ADF	Cont. equiv. (L_{Aeq}) or events (L_{AFmax})	Level Difference, external free field level – internal reverberant level, dB	
		Typical windows and vent	Higher acoustic performance windows and vent
1, 2	L_{Aeq}	21	31
	L_{AFmax}	22	35
3 (with trickle vent)	L_{Aeq}	23	33
	L_{AFmax}	24	38
4 (no trickle vent)	L_{Aeq}	27	38
	L_{AFmax}	31	45

Figure 7. Extract From AVOG 2020-Table B-2

7.3 Rigorous Calculations

The rigorous calculations have assumed the following.

For the ground floor Kitchen Lounge Diner (KLD), the Velux to the rear was added into the window glazed area total. In reality, this would likely be toughened or laminate glass and may offer a higher sound reduction index.

The daytime sound pressure level of 53dB $L_{Aeq,16hour}$ was used.

Bedroom 1 and Bedroom 2 are mirrored versions of each another.

Both through frame and through wall commercially available ventilation products have been assessed.

Standard thermal double glazing has been applied and whilst Pilkington Glass has been used as a reference, should alternative glazing providers be approached, then the minimum $R_{traffic}$ or R_w+C_{tr} to be considered is no less than 25dB(A). Please note that the $R_{traffic}/R_w+C_{tr}$ is the only comparable metric for glazing.

Rooms	External SPL	SRI Required	Window	Vent	Internal SPL	SRI Achieved
Ground Floor KLD	53	18	4\12\4	9x9 Airliner	30	24
Ground Floor KLD	53	18	4\12\4	2x Titon (5000mm ²)	31	22
Bedroom 1	53	18	4\12\4	Ryttons AAC135HP LookRyt	25	28
Bedroom 1	53	18	4\12\4	2x Titon (5000mm ²)	26	27

Figure 8. Rigorous Calculations (Summary)

7.4 Simplified Overheating Assessment (Building Regulations, Approved Document O)

As per section 3.4 above, Approved Document O allows a window to be opened overnight to mitigate thermal overheating where the internal sound pressure levels are less than 40dB $L_{Aeq,8 hour}$ and there are no more than 10 events above 55dB L_{Amax} inside a bedroom setting.

From Figure 4 above it was noted that the overnight values were 48dB. With a 10dB allowance for an open window as per the ANC Approved Document O Noise Guide, (November 2024) this would provide 38dB $L_{Aeq,8 hour}$ internally.

It is also required that L_{Amax} events are also considered. Again, with a 10dB open window this has an average of 6 events per night above 55dB L_{Amax} .

It is therefore arguable that the future occupants will be capable of opening windows to mitigate thermal overheating during the night time period.

8 Discussion (Condition 17)

The relevant section from condition 17 is replicated below.

“The report shall outline that the rating level from the ASHP shall not exceed 35dB $L_{Aeq15min}$ at any noise sensitive façade of a neighbouring residential premises”.

For the purposes of condition 17, a noise model was created using IMMI noise modelling software to allow the impact of the proposed air source heat pump to be assessed.

8.1 Noise Modelling Software

In order to see how noise varies at different positions around the proposed development it is possible to produce a noise contour map. A computer noise model has been completed using the computer package IMMI. Drawings of the area have been used to complete the noise models and the topography of the location recreated. IMMI faithfully implements the propagation method of ISO-9613:1996; Acoustics – Attenuation of sound during propagation outdoors.

The noise modelling software predicts freefield and A weighted dB values.

8.2 Noise Model Inputs

The noise model was created with the dimensions of the consented property.

The ASHP whilst having a sound power level of 61dB was modelled as 64dB to include the relevant wall reflection.

Receptor positions were added into both the adjacent property at 8 Holmbush Close as well as those to the immediate South and East.

Bungalows were entered as 5.5m in height above ground level

Ground floor receptors were added as 1.5m above ground level

First floor receptors were added as 4m above ground level

Flat roof garages were entered as 3m above ground level.

8.3 Noise Model Outputs

The 2D noise model output can be seen in Figure 9 below. A more detailed account of the predictions can be seen in Figure 10 below. Note that for the 2D noise model, the noise contours commence at 10dB.

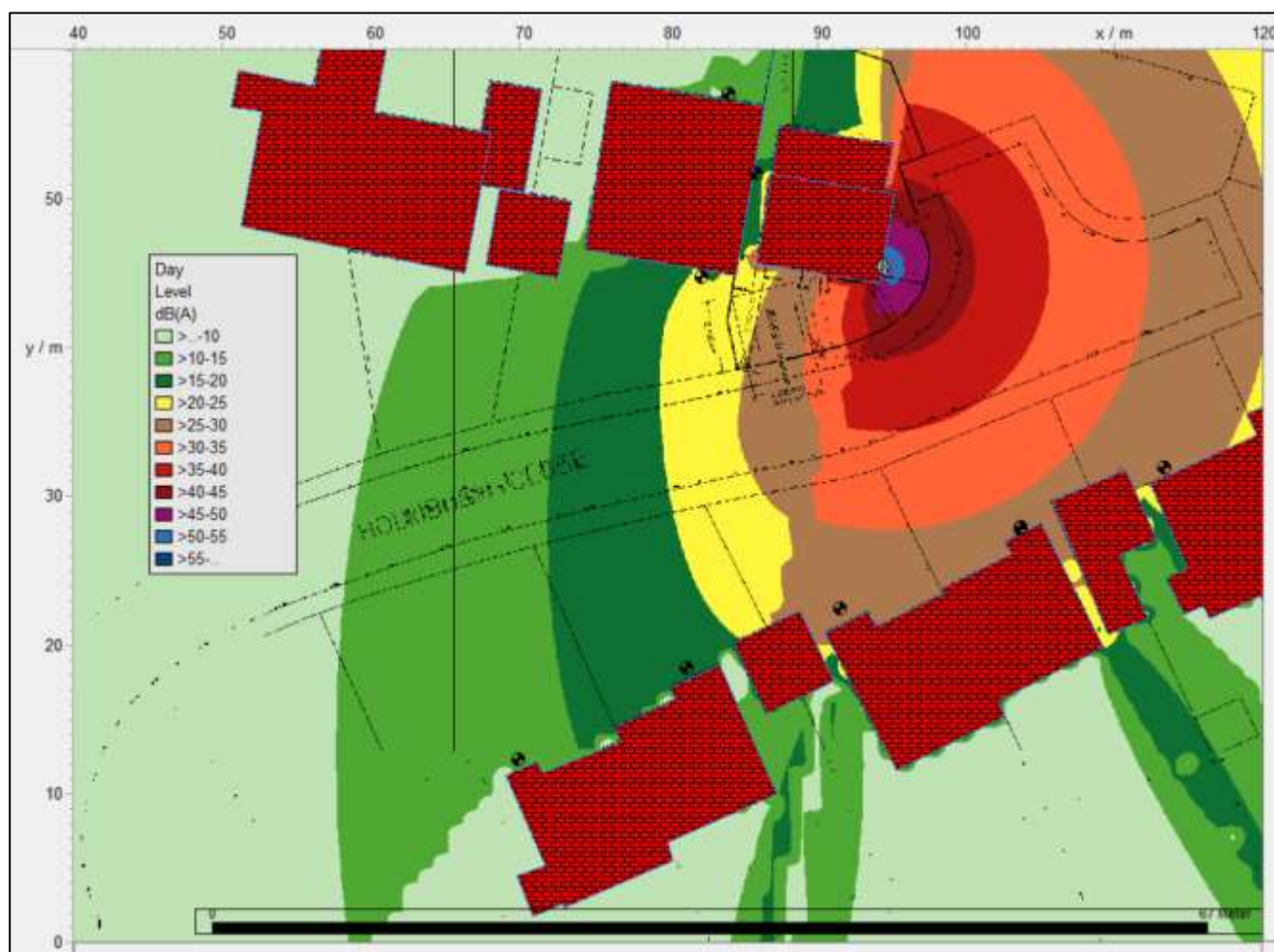


Figure 9. 2D Noise Contours

Predicted External $L_{Aeq,T}$ for ASHP	
Location	External $L_{Aeq,T}$
8 Holmbush GF	20.6
8 Holmbush CloseSide	15.4
8 Holmbush Rear	11.4
9 Holmbush Close GF	24.6
10 Holmbush Close	26.4
11 Holmbush Close	28.4
11 Holmbush Close FF	29.9
12 Holmbush GF	26.4
12 Holmbush FF	28.5
13 Holmbush Close	18.4
13 Holmbush Close FF	20.5
14 Holmbush GF	13.7
14 Holmbush FF	15.0

Figure 10. Noise Model Predictions

In summary, the noise modelling predicts a worst case external freefield sound pressure level of 30dB rounded at 11 Holmbush Close.

This is comfortably 5dB below the requirements of condition 17.

The predicted external sound pressure levels are also 17dB below the measured daytime background sound pressure levels and 7dB below the measured night time background sound pressure levels ($L_{A90,15minutes}$). Accordingly, these are unlikely to present any cause for concern.

Whilst the noise model assesses airborne propagation of sound energy, the client is advised that the manufacturers recommendations are followed with regards to anti vibration mounts for the unit and any piping infrastructure.

8.4 Noise Model Checking

A review of the noise model outputs remains good practice and 11 Holmbush Close is directly South of the ASHP at approximately 20.3m. With a sound power level of 64dB, this is calculated as follows :

$$64-20\log(20.3)-8=29.9\text{dB.}$$

The result is the same as the noise model and there remains confidence in the predictions and model outputs.

9 Conclusion

Condition 17 relates to the impact of a proposed Air Source Heat Pump and requires that this is less than 35dB $L_{Aeq,15minutes}$ at the nearest residential receptor. Condition 18 requires a soundscape assessment and subsequent scheme of mitigation measures to protect the future occupants of the property.

A sound survey was set up from 30th June 2026 to 6 July 2026 to measure the site soundscape at the location of the consented property. This showed average daytime sound pressure levels of 53dB $L_{Aeq,16\ hour}$ and average night time sound pressure levels of 48dB $L_{Aeq,8\ hour}$.

Rigorous calculations were undertaken to identify suitable glazing and/or ventilation to ensure noise levels were consistent with the requirements of Condition 18. The Sound Reduction Index requirements are relatively low (18dB) and are easily achieved with standard thermal double glazing and either through frame or through wall ventilation.

For condition 17, noise modelling software (IMMI) was used to consider the impact of a new Daikin external Air Source Heat Pump. This predicts an external sound pressure level of 30dB rounded at the nearest residential property to the South and is below the requirements of condition 17. The predicted external sound pressure levels from the ASHP are also 17dB below the daytime measured background sound pressure levels and 7dB below the night time measured background sound pressure levels.

Sufficient information has been presented in regard to conditions 17 and 18 in order that the local planning authority may discharge these conditions.

10 Appendix A – Rigorous Calculations

10.1 Ground Floor KLD

Non Frequency Dependent Variables			Key for Table Below				
Term	Derivation	Value	R _{wi}	Sound Reduction of Window (Octave)			
A _o	Given in BS EN 20140-10 = 10 (m^2)	10	R _{ew}	Sound Reduction Index of External Wall (Octave)			
S _f	Total Facade Area (m^2)	62.04	R _{rr}	Sound Reduction Index of Roof/Ceiling (Octave)			
S _{wi}	Window Area (m^2)	19.63	A	Equivalent Absorption Area of Rx Room			
S _{ew}	External Wall Area (m^2)	42.41	D _{n,e}	Insulation of Trickle Vent (BS EN 20140-10)			
S _{rr}	Ceiling Area (m^2)	24.5					
S	Total Area sound enters the room (m^2)	86.54					
Frequency Dependent Variables							
Term	Description	Octave Band Centre Frequency					
		125	250	500	1000	2000	4000
Leq,ff	Free-Field External Noise Level	55	51	49	49	46	39
D _{n,e}	Ryton 9x9 Airliner (38dB Open)	36	29	31	39	44	52
R _{wi}	4 12 4	24	20	25	35	38	35
R _{ew}	Cavity Masonry (Brick Cavity with Insulation lightweight block)	41	39	44	52	60	65
R _{rr}	Tile on Felt, Pitched Roof, 100mm mineral wool on plasterboard ceiling	28	34	43	43	43	43
A	Equivalent Absorption Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00
BS8233 Calculation Details							
Term From Equation Below	Octave Band Centre Frequency						
	125	250	500	1000	2000	4000	
Leq,ff	55	51	49	49	46	39	
A _o /S . 10^(-D _{n,e} /10)	2.9E-05	0.000145	9.18E-05	1.45E-05	4.6E-06	7.29E-07	
S _{wi} /S . 10^(-R _{wi} /10)	0.000903	0.002268	0.000717	7.17E-05	3.6E-05	7.17E-05	
S _{ew} /S . 10^(-R _{ew} /10)	3.89E-05	6.17E-05	1.95E-05	3.09E-06	4.9E-07	1.55E-07	
S _{rr} /S . 10^(-R _{rr} /10)	0.000449	0.000113	1.42E-05	1.42E-05	1.42E-05	1.42E-05	
10log10(S/A)+3	11.95824	10.91089	10.33097	10.33097	10.61126	10.61126	
Leq,2	38.48014	36.04085	28.58816	19.48284	14.03298	8.996624	
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1	
A-Weighted Leq	22.38014	27.44085	25.38816	19.48284	15.23298	9.996624	
A-Weighted Level Outside		53	Ground Floor KLD				
BS8233 Predicted Internal A-Weighted Level		31					
Predicted Building Envelope SRI		22					
BS8233 Calculation can be seen below:							
$L_{eq,2} \approx L_{eq,ff} + 10 \log_{10} \left(\frac{A_0}{S} 10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S} 10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S} 10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S} 10^{\frac{-R_{rr}}{10}} \right) + 10 \log_{10} \left(\frac{S}{A} \right) + 3$							

Non Frequency Dependent Variables			Key for Table Below				
Term	Derivation	Value	R _{wi}	Sound Reduction of Window (Octave)			
A _o	Given in BS EN 20140-10 = 10 (m^2)	10	R _{ew}	Sound Reduction Index of External Wall (Octave)			
S _f	Total Facade Area (m^2)	62.04	R _{rr}	Sound Reduction Index of Roof/Ceiling (Octave)			
S _{wi}	Window Area (m^2)	19.63	A	Equivalent Absorption Area of Rx Room			
S _{ew}	External Wall Area (m^2)	42.41	D _{n,e}	Insulation of Trickle Vent (BS EN 20140-10)			
S _{rr}	Ceiling Area (m^2)	24.5					
S	Total Area sound enters the room (m^2)	86.54					
Frequency Dependent Variables							
Term	Description	Octave Band Centre Frequency					
		125	250	500	1000	2000	4000
Leq,ff	Free-Field External Noise Level	55	51	49	49	46	39
D _{n,e}	2x Titon SF 5000	34.5	32.4	29.1	36.8	43.1	56.7
R _{wi}	4_12_4	24	20	25	35	38	35
R _{ew}	Cavity Masonry (Brick Cavity with Insulation lightweight block)	41	39	44	52	60	65
R _{rr}	Tile on Felt, Pitched Roof, 100mm mineral wool on plasterboard ceiling	28	34	43	43	43	43
A	Equivalent Absorption Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00
BS8233 Calculation Details							
Term From Equation Below	Octave Band Centre Frequency						
	125	250	500	1000	2000	4000	
Leq,ff	55	51	49	49	46	39	
A _o /S . 10^(-D _{n,e} /10)	4.1E-05	6.65E-05	0.000142	2.41E-05	5.66E-06	2.47E-07	
S _{wi} /S . 10^(-R _{wi} /10)	0.000903	0.002268	0.000717	7.17E-05	3.6E-05	7.17E-05	
S _{ew} /S . 10^(-R _{ew} /10)	3.89E-05	6.17E-05	1.95E-05	3.09E-06	4.9E-07	1.55E-07	
S _{rr} /S . 10^(-R _{rr} /10)	0.000449	0.000113	1.42E-05	1.42E-05	1.42E-05	1.42E-05	
10log10(S/A)+3	11.95824	10.91089	10.33097	10.33097	10.61126	10.61126	
Leq,2	38.51662	35.90626	28.84028	19.86767	14.11549	8.972439	
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1	
A-Weighted Leq	22.41662	27.30626	25.64028	19.86767	15.31549	9.972439	
A-Weighted Level Outside		53					
BS8233 Predicted Internal A-Weighted Level		31					
Predicted Building Envelope SRI		22					
BS8233 Calculation can be seen below:							
$L_{eq,2} \approx L_{eq,ff} + 10 \log_{10} \left(\frac{A_0}{S} 10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S} 10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S} 10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S} 10^{\frac{-R_{rr}}{10}} \right) + 10 \log_{10} \left(\frac{S}{A} \right) + 3$							

10.2 First Floor Bedroom

Non Frequency Dependent Variables			Key for Table Below	
Term	Derivation	Value	R _{wi}	Sound Reduction of Window (Octave)
A _o	Given in BS EN 20140-10 = 10 (m ²)	10	R _{ew}	Sound Reduction Index of External Wall (Octave)
S _f	Total Facade Area (m ²)	32.16	R _{rr}	Sound Reduction Index of Roof/Ceiling (Octave)
S _{wi}	Window Area (m ²)	3.73	A	Equivalent Absorption Area of Rx Room
S _{ew}	External Wall Area (m ²)	28.43	D _{n,e}	Insulation of Trickle Vent (BS EN 20140-10)
S _{rr}	Ceiling Area (m ²)	15		
S	Total Area sound enters the room (m ²)	47.16		

Frequency Dependent Variables							
Term	Description	Octave Band Centre Frequency					
		125	250	500	1000	2000	4000
Leq,ff	Free-Field External Noise Level	55	51	49	49	46	39
D _{n,e}	Ryttons AAC125HP Look Ryt	42	37	34	43	57	64
R _{wi}	4_12_4	24	20	25	35	38	35
R _{ew}	Cavity Masonry (Brick Cavity with Insulation lightweight block)	41	39	44	52	60	65
R _{rr}	Tile on Felt, Pitched Roof, 100mm mineral wool on plasterboard ceiling	28	34	43	43	43	43
A	Equivalent Absorption Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details						
Term From Equation Below	Octave Band Centre Frequency					
	125	250	500	1000	2000	4000
Leq,ff	55	51	49	49	46	39
A _o /S . 10 [^] (-D _{n,e} /10)	1.34E-05	4.23E-05	8.44E-05	1.06E-05	4.23E-07	8.44E-08
S _{wi} /S . 10 [^] (-R _{wi} /10)	0.000315	0.000791	0.00025	2.5E-05	1.25E-05	2.5E-05
S _{ew} /S . 10 [^] (-R _{ew} /10)	4.79E-05	7.59E-05	2.4E-05	3.8E-06	6.03E-07	1.91E-07
S _{rr} /S . 10 [^] (-R _{rr} /10)	0.000504	0.000127	1.59E-05	1.59E-05	1.59E-05	1.59E-05
10log ₁₀ (S/A)+3	9.321811	8.274458	7.694538	7.694538	7.974825	7.974825
Leq,2	33.76781	29.42701	22.4287	14.12833	8.673385	3.12668
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	17.66781	20.82701	19.2287	14.12833	9.873385	4.12668

A-Weighted Level Outside	53
BS8233 Predicted Internal A-Weighted Level	25
Predicted Building Envelope SRI	28

First Floor Bedroom 1

BS8233 Calculation can be seen below:	
$L_{eq,2} \approx L_{eq,ff} + 10 \log_{10} \left(\frac{A_0}{S} 10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S} 10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S} 10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S} 10^{\frac{-R_{rr}}{10}} \right) + 10 \log_{10} \left(\frac{S}{A} \right) + 3$	

Non Frequency Dependent Variables			Key for Table Below				
Term	Derivation	Value	R _{wi}	Sound Reduction of Window (Octave)			
A _o	Given in BS EN 20140-10 = 10 (m^2)	10	R _{ew}	Sound Reduction Index of External Wall (Octave)			
S _f	Total Facade Area (m^2)	32.16	R _{rr}	Sound Reduction Index of Roof/Ceiling (Octave)			
S _{wi}	Window Area (m^2)	3.73	A	Equivalent Absorption Area of Rx Room			
S _{ew}	External Wall Area (m^2)	28.43	D _{n,e}	Insulation of Trickle Vent (BS EN 20140-10)			
S _{rr}	Ceiling Area (m^2)	15					
S	Total Area sound enters the room (m^2)	47.16					
Frequency Dependent Variables							
Term	Description	Octave Band Centre Frequency					
		125	250	500	1000	2000	4000
Leq,ff	Free-Field External Noise Level	55	51	49	49	46	39
D _{n,e}	2x Titon SF 5000	34.5	32.4	29.1	36.8	43.1	56.7
R _{wi}	4_12_4	24	20	25	35	38	35
R _{ew}	Cavity Masonry (Brick Cavity with Insulation lightweight block)	41	39	44	52	60	65
R _{rr}	Tile on Felt, Pitched Roof, 100mm mineral wool on plasterboard ceiling	28	34	43	43	43	43
A	Equivalent Absorption Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00
BS8233 Calculation Details							
Term From Equation Below	Octave Band Centre Frequency						
	125	250	500	1000	2000	4000	
Leq,ff	55	51	49	49	46	39	
A _o /S . 10^(-D _{n,e} /10)	7.52E-05	0.000122	0.000261	4.43E-05	1.04E-05	4.53E-07	
S _{wi} /S . 10^(-R _{wi} /10)	0.000315	0.000791	0.00025	2.5E-05	1.25E-05	2.5E-05	
S _{ew} /S . 10^(-R _{ew} /10)	4.79E-05	7.59E-05	2.4E-05	3.8E-06	6.03E-07	1.91E-07	
S _{rr} /S . 10^(-R _{rr} /10)	0.000504	0.000127	1.59E-05	1.59E-05	1.59E-05	1.59E-05	
10log10(S/A)+3	9.321811	8.274458	7.694538	7.694538	7.974825	7.974825	
Leq,2	34.06276	29.749	24.10546	16.19128	9.936912	3.16537	
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1	
A-Weighted Leq	17.96276	21.149	20.90546	16.19128	11.13691	4.16537	
A-Weighted Level Outside		53					
BS8233 Predicted Internal A-Weighted Level		26					
Predicted Building Envelope SRI		27					
BS8233 Calculation can be seen below:							
$L_{eq,2} \approx L_{eq,ff} + 10 \log_{10} \left(\frac{A_0}{S} 10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S} 10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S} 10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S} 10^{\frac{-R_{rr}}{10}} \right) + 10 \log_{10} \left(\frac{S}{A} \right) + 3$							