20 HILLLSIDE AVENUE, WORTHING

Plant Noise Assessment

Reference: 13384.RP01.PNA.0
Prepared: 4 March 2024
Revision Number: 0

Grant Packham
20 Hillside Avenue
Worthing
BN14 9QS

Plant Noise Assessment

20 HILLLSIDE AVENUE, WORTHING

Reference: 13384.RP01.PNA.0
Prepared: 4 March 2024

Revision	Comment	Date	Prepared By	Approved By
0	First issue of report	4 March 2024	Matt Wildman	Martin Raisborough

Terms of contract:

RBA Acoustics Ltd have prepared this report in accordance with our Scope of Work 13384.SW01.0 dated 20 December 2023. RBA Acoustics Ltd shall not be responsible for any use of the report or its contents for any purpose other than that for which it was provided. Should the Client require the distribution of the report to other parties for information, the full report should be copied. No professional liability or warranty shall be extended to other parties by RBA Acoustics Ltd without written agreement from RBA Acoustics Ltd.

The recommendations within this report relate to acoustics performance only and will need to be integrated within the overall design by the lead designer to incorporate all other design disciplines such as fire, structural integrity, setting-out, etc. Similarly, any sketches appended to this report illustrate acoustic principles only and will need to be developed into full working drawings by the lead designer to incorporate all other design disciplines.

RBA ACOUSTICS

LONDON
44 Borough Road
London SE1 0AJ
T. +44 (0) 20 7620 1950

MANCHESTER
Bloc, 17 Marble Street
Manchester, M2 3AW
T. +44 (0) 161 661 4504

Contents

1. INTRODUCTION 1

2. SITE DESCRIPTION 1

3. ASSESSMENT CRITERIA 1

4. ENVIRONMENTAL NOISE MONITORING 3

5. PLANT NOISE IMPACT ASSESSMENT 5

6. CONCLUSION 8

APPENDIX A – ACOUSTIC TERMINOLOGY

APPENDIX B – INSTRUMENTATION

APPENDIX C – PLANT CALCULATIONS

APPENDIX E – GRAPHS AND SITE PLANS

1. INTRODUCTION

RBA Acoustics has been appointed to undertake an assessment of atmospheric noise emissions from an air source heat pump located within the rear garden of 20 Hillside Avenue, Worthing, West Sussex.

Measurements of noise from the unit in operation, and the prevailing background noise climate at the site with the unit switched off, have been undertaken to assess the impact of atmospheric noise emissions upon the nearest noise sensitive receptors in accordance with the requirements of the Local Authority and *British Standard 4142:2014 - "Methods for rating and assessing industrial and commercial sound".* This report presents the results of the noise measurements, associated criteria and provides the required assessment.

A summary of acoustic terminology is included in Appendix A.

2. SITE DESCRIPTION

20 Hillside Avenue is a detached residential property located on the northern outskirts of the town of Worthing, West Sussex. The property is located in a predominately residential area. The A24, Warren Road, is located some 130 metres to the West of the site, noise from which is audible within the rear garden of the property. Worthing golf course is located approximately 80 metres to the north of the site.

A swimming pool is situated in the rear garden of the property, with an associated air source heat pump located towards the southern end of the garden.

The site is shown in relation to its surroundings in the site plan in Figure 1 (Appendix E).

3. ASSESSMENT CRITERIA

The relevant standards and guidelines for the assessment of the impact noise from fixed plant items upon nearby noise sensitive properties is presented below:

3.1 British Standard 4142

BS 4142:2014 *Methods for rating and assessing industrial and commercial sound* describes methods for rating and assessing sound of an industrial and/or commercial nature, which includes:

- sound from industrial and manufacturing processes
- sound from fixed installations which comprise mechanical and electrical plant and equipment
- sound from the loading and unloading of goods and materials at industrial and/or commercial premises
- sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

The methods described within BS 4142:2014 use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

The assessment method described in BS 4142:2014 is based on the continuous sound pressure level produced by a specific source ($L_{Aeq,Tr}$) at the assessment location. Appropriate corrections allowing for any tonality, impulsivity, other characteristics or intermittency of the specific sound source are then applied to derive the rating level ($L_{Ar,Tr}$). The rating level is then compared to the background sound level ($L_{A90,T}$) to

produce the relative difference, or excess of rating level over background sound level. BS 4142:2014 quantifies the estimated impact from the excess as:

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

Based on the above guidance, it is recommended that noise from the plant does not exceed a rating sound level of greater than 5dB below the otherwise background sound level at the nearest noise sensitive property in order to ensure that there is no adverse impact due to noise.

Notwithstanding the above, however, it is recognised that imposing a noise emission limit below 35dBA is both; unnecessary and unenforceable to achieve acceptable conditions at the nearest existing noise-sensitive properties, For example, Section 1 of (the now superseded) BS 4142: 1997, states

"The method is not suitable for assessing the noise measured inside buildings or when the background and rating noise levels are both very low…For the purposes of the standard, background noise levels below about 30dB and rating levels below about 35dB are considered to be very low"

The ability of (Class 1) measurement instrumentation is considered increasingly unreliable to measure the noise contribution of new plant where rating and background noise levels are very low.

3.2 Local Authority Requirements

The Local Authority has also presented their specific requirements for the control of noise from the condenser unit, in an email from Oliver Rochford of Worthing Council Environmetal Health team dated 4th January 2024:

> *"Following the monitoring visit to both the applicant and their neighbour, we have carefully considered this matter in an attempt to determine the level of reduction required to ensure that the ASHP will not lead to a loss of amenity or cause a nuisance to the neighbour.*
>
> *The noise was measured at source at 64.4dB LAeq1min (61.4dBA free field) and 44.8dB LAeq1min at the facade of 18 Hillside Avenue. The measurement on the rear patio of 18 Hillside was 48.1dB LAeq1min (LA901min = 46.6dB).*
>
> *In order to achieve the levels suggested in the CIEH/IoA guidance: 'Heat Pumps, Professional Advice note', we believe a 14dBA reduction is required to ensure that the ASHP would be no louder than the background level at the nearest facade of the neighbours property. I am aware acoustic enclosures may be available for the ASHP, although ultimately how this reduction is achieved is down to the applicant.*
>
> *Therefore, we recommend the following information is submitted for consideration:*
>
> *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. This report must detail how the 14dBA reduction is to be achieved, through the use of acoustic enclosures or other measures proposed.

Following completion of the mitigation works, noise monitoring shall be undertaken by the applicant at the reasonable request of the Local Planning Authority to confirm the required level has been achieved.

Based on the above, noise from the installed air source heat pump should not exceed a rating noise level of 35dB $L_{Ar,\ 15minutes}$

The above standards and Local Authority guidance will be considered in the subsequent assessments of noise from the installed condenser unit.

4. ENVIRONMENTAL NOISE MONITORING

4.1 Survey Methodology

Monitoring of the prevailing background noise levels at the site was undertaken over the following period:

- 13:00 Thursday 8th February to 10:45 Tuesday 13th February 2024.

As the survey was unattended it is not possible to comment with certainty regarding meteorological conditions throughout the entire survey period. It is noted that weather reports for the area over the survey duration suggest some raingall occurred over certain periods of the survey, however, these periods were short in duration and were not thought to have significantly influenced the outcome of the survey. As such the results are considered to be a representative sample of the typical background noise climate on site.

Measurements were made of the L_{A90}, L_{Amax} and L_{Aeq} noise levels over sample periods of 15 minutes.

4.2 Measurement Location

To determine the existing noise climate around the site measurements were undertaken at the following location:

- Measurement Position 1 – Rear Garden, close to western boundary with 18 Hillside Avenue

Measurements were taken with the microphone fixed to a pole and attached to a garden trellis near the western boundary of the garden shared with 18 Hillside Avenue. The microphone was elevated approximately 3m above ground level in free field conditions. The prevailing noise climate consisted mainly of traffic noise from the A24 and birdsong. Measurements at this position are considered to be representative of the background noise climate experienced at the rear façade and garden of 18 Hillside Avenue.

The measurement position is also illustrated on the site plan attached in Figure 1 and photo in Figure 2 (Appendix E).

4.3 Instrumentation

For information regarding the equipment used for the measurements please refer to Appendix B.

The sound level meter was calibrated both prior to and on completion of the survey with no significant calibration drift observed.

4.4 Results

The full results of the noise levels measured during the survey are shown as time-histories on the attached Graphs 1 – 3 in Appendix D.

The representative background L_{A90} and the period averaged L_{Aeq} noise levels measured are summarised below. Selection of an appropriately representative background sound level is discussed in BS 4142:2014 as follows:

> *"In using the background sound level in the method for rating and assessing industrial and commercial sound it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods."*

BS 4142:2014 suggests that statistical analysis is a suitable method to determine the "typical" background level. This can be carried out by calculating the level of the most-commonly occurring $L_{A90,\ 15mins}$ period during the proposed operating hours of equipment.

We generally consider that designing to the most-commonly occurring $L_{A90,\ 15mins}$ period is not sufficient during those slightly quieter periods. In our opinion, a more representative value would be the "typical-lowest" level, which can be determined statistically as the lowest rounded $L_{A90,\ 15mins}$ level which occurs for at least 10% of the assessment period. The relative proportions of $L_{A90,15min}$ noise levels measured over the survey period can be seen in the histogram shown in Graph 3 in Appendix E.

The lowest $L_{A90,15min}$ and the period averaged L_{Aeq} noise levels measured are summarised below.

Table 1 – Measured Baseline Noise Levels

Measurement Period	Typical Lowest Background Noise Level $L_{A90,15min}$ (dB)	Period-Averaged Noise Level $L_{Aeq,T}$ (dB)
Daytime (07:00 – 23:00)	37	51
Night-time (23:00 – 07:00)	27	46

5. PLANT NOISE IMPACT ASSESSMENT

5.1 Plant Noise Emission Limits

Based on the results of the environmental noise monitoring survey at the site, the typical lowest background sound level during the night time is less than 30dBA. In line with the guidance in Section 3.1, the minimum BS 4142 threshold for background sound levels is 30dB L_{A90} and the associated minimum BS 4142 threshold for rating sound level for the plant is 35dB $L_{Ar,T}$.

This minimum threshold corresponds with the requirement of the Local Authority for noise from the plant to not exceed 35dB $L_{Ar,\ 15\ minutes}$.

5.2 Location of Plant and Nearest Noise Sensitive Receptor

The air source heat pump is located near the northern end of the rear garden of 20 Hillside Avenue. The nearest noise sensitive receptor to the plant is 18 Hillside Avenue, another detached residential property that is immediately adjacent to 20 Hillside Avenue. The rear facing first floor window of 18 Hillside Avenue is located approximately 17 metres from the heat pump, and directly overlooks it.

5.3 Plant Noise Levels

Noise emissions from the air source heat pump in-situ operating at maximum capacity were measured 1m in front of the unit off-axis (as is the nearest noise sensitive receptor). Background noise levels on site were sufficiently low enough to have not contributed to the measured noise levels.

The measured noise levels from the air source heat pump are shown in Table 2 below:

Table 2 – Plant Noise Levels

Unit	Sound Level (dB re $20x10^{-6}$ Pa.) at 1 metre @ Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Air Source Heat Pump - Waterco Electroheat Plus MKIII	70	74	65	61	62	55	53	47	66

Review of the octave band data and our subjective impressions of the unit during our time on site indicate no tonal characteristics associated with the heat pump.

5.4 Calculation of Noise Levels at Nearest Noise-Sensitive Receptors

Our calculation method for predicting noise levels from the proposed external plant at the nearest noise-sensitive receptors, based on the information above, is summarised below.

- Source Term (L_p)
- Distance Attenuation
- Screening

Calculation sheets are attached for further information in Appendix C.

The results of the calculations indicate the following noise levels at the nearest affected residential windows:

Table 3 – Predicted Plant Noise Levels

Parameter	Noise Levels (dBA)	Commentary
Receptor 1 – 18 Hillside Avenue, Rear Façade		
Condenser Unit Rating level @ Façade of 18 Hillside Avenue $L_{Ar,Tr}$	41 dB $L_{Ar,T}$	Rating sound Level (dB $L_{Ar,T}$)
Night-time plant noise emission limit (dB $L_{Ar,T}$)	35dB $L_{Ar,T}$	Recommended Plant Noise Emission Limit (dB $L_{Ar,T}$)
Excess above limit (dBA)	+6	Installation is currently above the proposed plant noise emission limit.

Calculation sheets are attached for further information in Table C1 of Appendix C.

From the results of the assessment in Table 3 above it can be seen that noise from the condenser unit is above the recommended noise emission limit at the façade of the adjacent noise sensitive property. As such, mitigation measures are required in order to reduce the impact of nosie from the plant.

5.5 Proposed Mitigation Measures

It is proposed to install a 2.2m high fence lined with integral acoustically absorptive material facing the air source heat pump, completely screening the heat pump from the receptor point. The proposed product is a Rockwool Noistop acoustic fence.

The results of the calculations incorporating this mitigation proposal installed approximately 1m in front of the unit - completely screening the unit from Receptor 1 - indicate the following noise levels at the nearest affected residential windows:

Table 4 – Predicted Plant Noise Levels (with Mitigation)

Parameter	Noise Levels (dBA)	Commentary
Receptor 1 – 18 Hillside Avenue, Rear Façade		
Condenser Unit Rating level @ Façade of 18 Hillside Avenue $L_{Ar,Tr}$	27dB $L_{Ar,T}$	Rating sound Level (dB $L_{Ar,T}$)
Night-time plant noise emission limit (dB $L_{Ar,T}$)	35dB $L_{Ar,T}$	Recommended Plant Noise Emission Limit (dB $L_{Ar,T}$)
Excess above limit (dBA)	-8	Installation is below the proposed plant noise emission limit.

Calculation sheets are attached for further information in Table C2 of Appendix C.

Noise from the operation of the condenser unit with the proposed mitigation installations is 8 dBA below the recommended noise emission limit at at the façade of the adjacent noise sensitive property.

6. CONCLUSION

RBA Acoustics has been appointed to undertake an assessment of atmospheric noise emissions from an air source heat pump located within the rear garden of 20 Hillside Avenue, Worthing, West Sussex.

Measurements of noise from the unit in operation, and the prevailing background noise climate at the site with the unit switched off, have been undertaken to assess the impact of atmospheric noise emissions upon the nearest noise sensitive receptors in accordance with the requirements of the Local Authority and *British Standard 4142:2014 - "Methods for rating and assessing industrial and commercial sound".*

The results of the assessment indicate that, at present, atmospheric noise emissions from the air source heat pump are likely to be above the proposed criteria established in line with BS4142 guidance at the nearest noise sensitive receptors. Acoustic fencing has been recommended to a minimum height of 2.2 metres from the ground to reduce the predicted plant noise level at the nearest noise sensitive receptors. Predictions show that with the fencing installed approximately 1 metre in front of the unit, noise emissions can be attenuated to levels below the established criteria.

As such, the plant installation should be considered acceptable in terms of noise and is in line with the noise limits required by the Local Authority.

Appendix A – Acoustic Terminology

A-weighting (e.g. dB(A))	A correction applied across the frequency bands to take into account the response of the human ear, and therefore considered to be more representative of the sound levels people hear.
DeciBel (dB)	Unit used for many different acoustic parameters. It is the logarithmic ratio of the level being assessed to a standard reference level.
L_{eq}	The level of a notional steady sound which, over a stated period of time, T, would have the same acoustic energy as the fluctuating noise measured over that period. Typically used to represent the average or ambient noise level.
$L_{Aeq,T}$	The A-weighted level of a notional steady sound which, over a stated period of time, T, would have the same acoustic energy as the fluctuating noise measured over that period. Typically used to represent the average or ambient noise level.
L_{An} (e.g. L_{A10}, L_{A90})	The sound level exceeded for n% of the time. E.g. L_{A10} is the A-weighted level exceeded for 10% of the time and as such can be used to represent a typical maximum level. Similarly, L_{A90} is the level exceeded for 90% of the measurement period, and is often used to describe the underlying background noise.
NR	Noise Rating – A single figure term to describe a measured noise level which considers the frequency content of the noise, generally used for internal noise level measurements (particularly mechanical services plant).

Appendix B – Instrumentation

The following equipment was used for the measurements.

Table B1– Equipment Calibration Details

Manufacturer	Model Type	Serial No.	Calibration	
			Certificate No.	Valid Until
Norsonic Type 1 Sound Level Meter	Nor140	1406255	U44039	18 April 2025
Norsonic Pre Amplifier	1209	20491		
Norsonic ½“ Microphone	1225	225529	44038	18 April 2025
Norsonic Sound Calibrator	1251	34391	U440373	18 April 2025

Appendix C – Plant Calculations

Table C1 – Example Calculation, ASHP to Receptor 1 (no mitigation)

Calculation	Sound Level (dB) at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Source Sound Pressure Level (L_p@1m)	70	74	65	61	62	55	53	47	**66**
Distance Loss (Point Source) (14m)	-25	-25	-25	-25	-25	-25	-25	-25	-
Rating Corrections*	0	0	0	0	0	0	0	0	-
Screening	0	0	0	0	0	0	0	0	-
Resulting Level at Receptor (L_{eq})	45	49	40	36	37	31	28	22	**41**

Table C2 – Example Calculation, ASHP to Receptor 1 (with mitigation)

Calculation	Sound Level (dB) at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Source Sound Pressure Level (L_p@1m)	70	74	65	61	62	55	53	47	**66**
Distance Loss (Point Source) (14m)	-25	-25	-25	-25	-25	-25	-25	-25	-
Rating Corrections*	0	0	0	0	0	0	0	0	-
Acoustic Fence Screening	-8	-10	-12	-15	-18	-20	-20	-20	-
Resulting Level at Receptor (L_{eq})	37	39	28	21	19	10	8	2	**27**

* The condenser unit is fitted with an inverter driver such that the fan ramps up and down slowly with duty, such that there is not intermittency, In addition, the unit does not exhibit any tonal components that would warrant a tonal correction. As such, not distiguidable noise characteristics are considered apartment at the nearby receptor that would warrant any acoustric feature corrections in accordance with the methodology in BS 4142.

Appendix E – Graphs and Site Plans

20 Hillside Avenue, Worthing

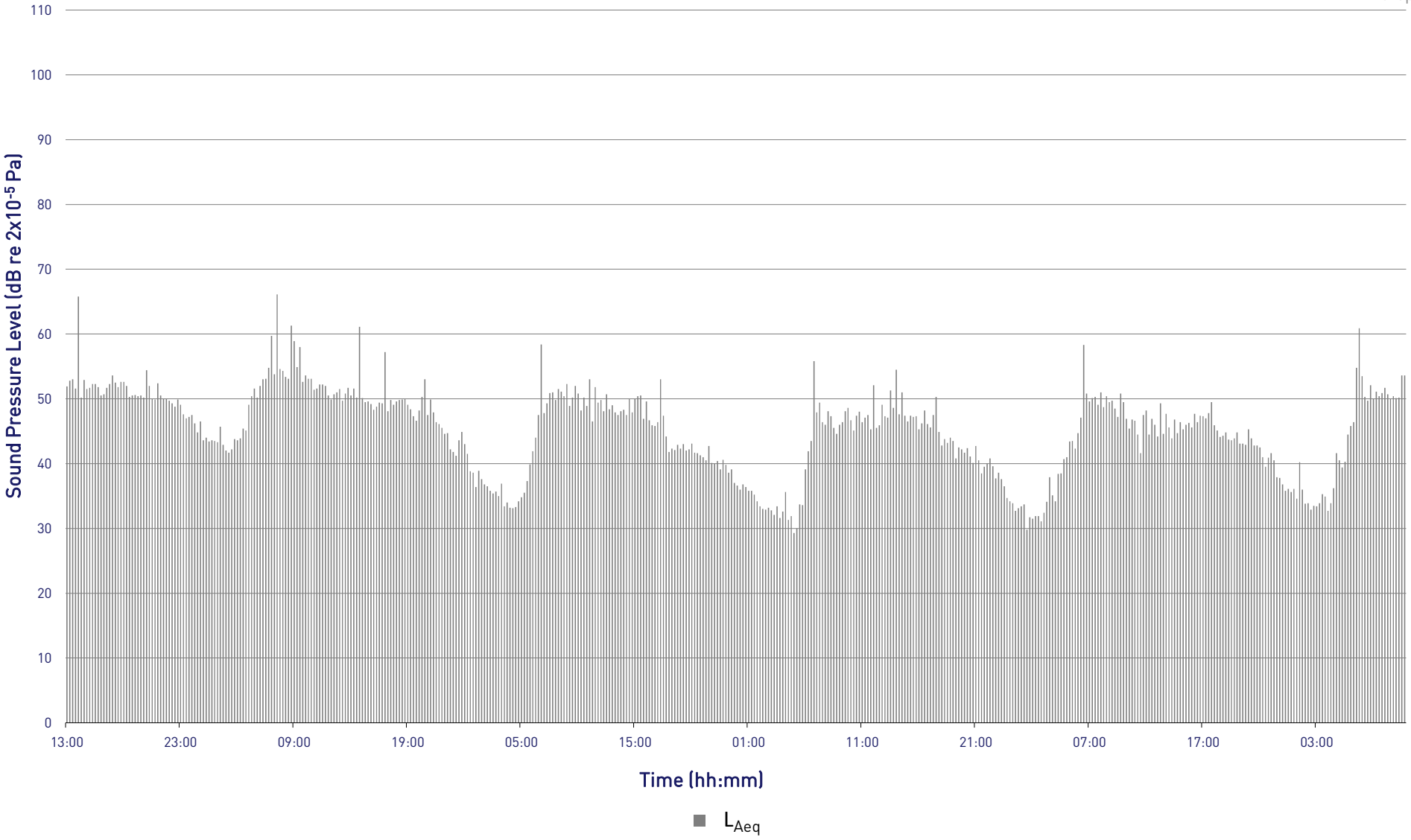
L_{Aeq} Time History

Measurement Position 1 - Rear Garden, Thursday 8th February to Tuesday 13th February 2024

RBA ACOUSTICS

Project: 13384

Graph 1



20 Hillside Avenue, Worthing

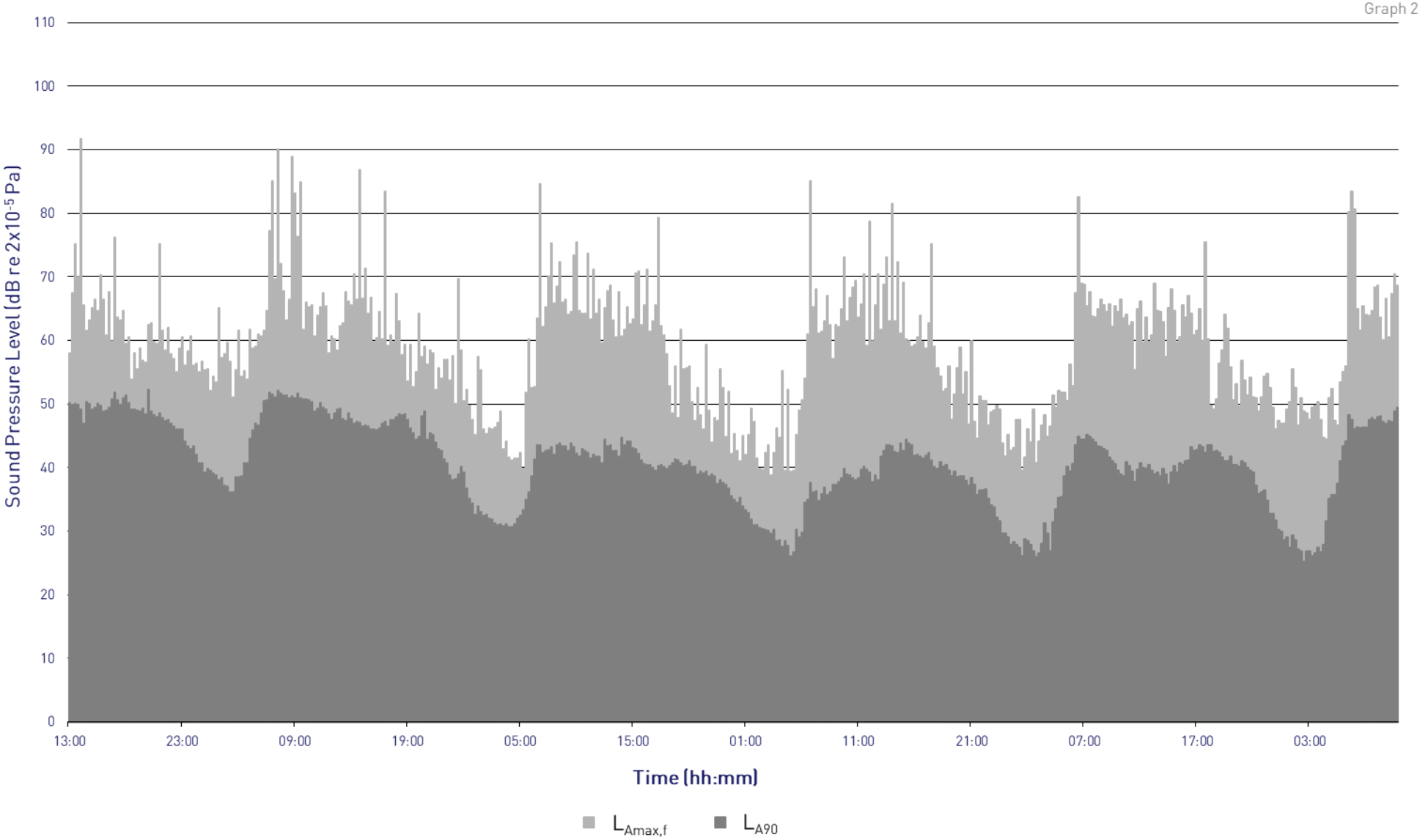
$L_{Amax,f}$ and L_{A90} Time History

Measurement Position 1 - Rear Garden, Thursday 8th February to Tuesday 13th February 2024

RBA ACOUSTICS

Project: 13384

Graph 2



20 Hillside Avenue, Worthing

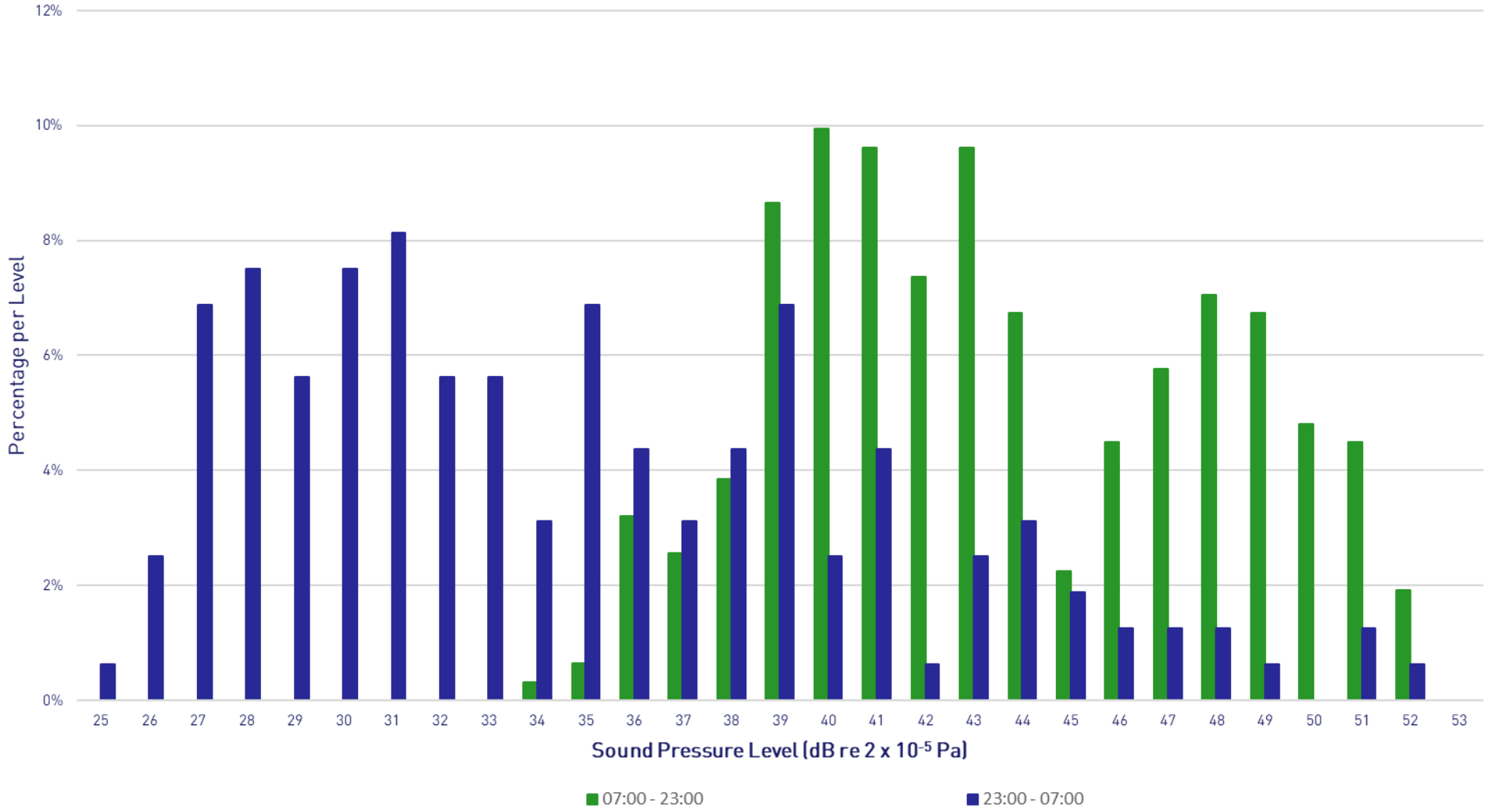
$L_{A90,15\ minutes}$ Histogram

Measurement Position 1 - Rear Garden, Thursday 8th February to Tuesday 13th February 2024

RBA ACOUSTICS

Project: 13384

Graph 3





20 Hilllside Avenue, Worthing

Site Plan

Project 13384

Figure 1

4 March 2024

Not to Scale

RBA ACOUSTICS



20 Hilllside Avenue, Worthing

Photograph of Measurement Position

Project 13384

Figure 2

4 March 2024

Not to Scale

RBA ACOUSTICS

RBA ACOUSTICS
W. www.rba-acoustics.co.uk
E. info@rba-acoustics.co.uk

London:
44 Borough Road
London SE1 0AJ
T. +44 (0) 20 7620 1950

Manchester:
Bloc, 17 Marble Street
Manchester M2 3AW
T. +44 (0) 161 661 4504

