Noise CONSULTANTS

Noise Assessment:
43 Quenby Street,

May 2021






Experts in noise and vibration assessment and management

Document Control

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1 Introduction

1.1 Noise Consultants Ltd (NCL) has been instructed to carry out an assessment to identify the potential effects of sound at the nearest noise sensitive receptors (NSRs) resulting from an Air Source Heat Pump (ASHP) installation at 43 Quenby Street, Hulme, Manchester (M15 4HX).

1.2 This report presents the findings of a baseline sound survey and the results of an assessment of sound impacts resulting from the proposed installation. This report has been prepared in accordance with National legislation, policies, and guidance and by reference to appropriate British and International standards.

1.3 An assessment has been undertaken with reference to BS 4142:2014+A1:2019 '*Methods for rating and assessing industrial and commercial sound*' by reference to baseline noise survey data.

1.4 An assessment has been conducted of predicted sound levels from the proposed ASHP installation at the nearest NSRs based on manufacturers sound emission data for the units. This has been conducted to determine whether further mitigation is required for the proposed installation.

2 Relevant Policy and Guidance

National Policy

Noise Policy Statement for England (NPSE, 2010)

2.1 The Noise Policy Statement for England (NPSE, 2010) sets out the Government's Noise Policy Vision to:

"Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development".

2.2 This long-term vision is supported by three Noise Policy Aims that can be delivered through effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development. These aims are to:

1. *avoid significant adverse impacts on health and quality of life;*
2. *mitigate and minimise adverse impacts on health and quality of life; and*
3. *where possible, contribute to the improvement of health and quality of life.*

2.3 The explanatory note to the NPSE sets out 'effect levels' which are aligned to the Policy Aims. Drawing upon established concepts from toxicology, the NPSE defines the following noise effect levels:

- NOEL - 'No Observed Effect Level';
- LOAEL - 'Lowest Observed Adverse Effect Level'; and
- SOAEL - 'Significant Observed Adverse Effect Level'.

2.4 The explanatory note describes SOAEL as the effect level above which significant adverse effects on health and quality of life occur, aligning this level with the first policy aim.

2.5 LOAEL is described as the level at which adverse effects begin and the second aim of the NPSE refers to a situation where the effect lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development (paragraph 1.8 of the NPSE) however this does not mean that such adverse effects cannot occur.

2.6 NOEL is described as a level of noise exposure below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life.

2.7 The third aim seeks, where possible, to positively improve health and quality of life through the pro-active management of noise while also taking into account the guiding principles of sustainable

development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society.

2.8 The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim.

2.9 NPSE states that it is not possible have a single, numerical definition of the SOAEL that is applicable to all sources of noise in all situations, since the SOAEL is likely to be different for different noise sources, for different receptors and at different times.

National Planning Policy Framework (NPPF, 2019)

2.10 The National Planning Policy Framework (NPPF, 2019) sets out the Government's planning policies for England and how these should be applied. The NPPF provides a framework within which locally-prepared plans for housing and other development can be produced.

2.11 In relation to noise, it states:

"170. Planning policies and decisions should contribute to and enhance the natural local environment by: …

- *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. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and …."*

2.12 The NPPF includes policy which makes reference to 'significant adverse impacts on health and quality of life', as per the NPSE. NPPF policy states:

"180. Planning policies and decisions should aim to 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:

- *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 life;*
- *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and…"*

Planning Practice Guidance – Noise (PPG-Noise, 2019)

2.13 The Planning Practice Guidance (PPG-Noise, 2019) provides further detail about how the effects of noise can be described in terms of perception and outcomes. The noise exposure hierarchy is presented in **Table 1**. It is aligned with increasing effect levels as defined in the NPSE but adds a fourth 'Unacceptable Adverse Effect Level' (UAEL).

2.14 This effect level is higher than the significant adverse effect on health and quality of life (SOAEL) and PPG-Noise requires that unacceptable adverse effects be prevented.

2.15 This noise exposure hierarchy is based on the principle that once noise or vibration becomes perceptible, the effect on people and other receptors increases as the level increases. PPG-Noise presents example outcomes to help characterise these effects using non-technical language. In general terms, an observed adverse effect is characterised as a perceived change in quality of life for occupants of a building or a perceived change in the acoustic character of an area, whereas a significant observed adverse effect disrupts activities.

2.16 PPG-N does not provide numerical values for the effect levels, instead PPG-N recognises that "*the subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation*".

2.17 These factors include:

- *"The source and absolute level of the noise together with the time of day it occurs. Some types and levels of noise will cause a greater adverse effect at night than if they occurred during the day - this is because people tend to be more sensitive to noise at night as they are trying to sleep. The adverse effect can also be greater simply because there is less background noise at night."*
- *"For non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise."*
- *"The spectral content of the noise (i.e. whether or not the noise contains particular high or low frequency content) and the general character of the noise (i.e. whether or not the noise contains particular tonal characteristics or other particular features). The local topology and topography should also be taken into account along with the existing and, where appropriate, the planned character of the area."*
- *"Consideration should also be given to whether any adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time (and the effect this may have on living conditions.)"*

Table 1: Planning Practice Guidance – Noise Exposure Hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, 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 perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour and/or attitude, 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
Present and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

2.18 The setting of LOAELs and SOAELs for transportation sources has reached a form of consensus following a number of high-profile infrastructure projects in England, namely HS2 and a series of Highways England road schemes which have been successful through the Government's Hybrid Bill and Development Consent Order (DCO) consenting processes.

2.19 However, the setting of LOAELs and SOAELs for building services noise is not well rehearsed. Because the recognised assessment of these types of sources is based on the prominence of the sound source relative to baseline levels, it does not readily lend itself to a single threshold value. In the following section LOAEL values have been selected for this type of noise source based on professional experience and consideration of associated standards and guidance.

Guidance

British Standard 4142:2014+A1:2019 '*Methods for rating and assessing industrial and commercial sound*'

2.20 BS 4142:2014+A1:2019 is used to rate and assess sound of an industrial nature including but not limited to assessing sound from proposed, new, modified or additional sources of industrial sound. It contains guidance on the monitoring and assessment of industrial and commercial sound sources (including fixed installations comprising mechanical and electrical plant and equipment) affecting sensitive receptors.

2.21 The methodology relies on comparing the operational rating level, $L_{Ar,Tr}$, with the background sound level, $L_{A90,T}$ (i.e. the level that would be present without the development) over a representative time period. BS 4142:2014+A1:2019 provides guidance on the measurement of background sound, the determination of specific sound and calculation of the rating level.

2.22 Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. A character correction should be added to the specific sound level to obtain the rating level, where such features are present at the assessment location. It states that the specific sound level should be corrected if a tone, impulse or other characteristic occurs, or is expected to be present for new sound sources.

2.23 BS 4142:2014+A1:2019 assessment methodology also states that:

- *"Typically, the higher the rating level is above the background sound level the greater the magnitude of impact;*
- *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;*
- *A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and*

- *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."*

2.24 In order to determine the impact threshold levels for the assessment of operational industrial sound, the difference between the rating level and background sound level is considered, as advocated by the methodology within BS 4142:2014+A1:2019.

3 Significance Criteria

3.1 **Table 2** summarises the proposed threshold levels relating to operational sound.

Table 2: Proposed LOAEL and SOAEL Criteria by reference to BS 4142:2014+A1:2019

Period	LOAEL	SOAEL
Daytime (0700-2300hrs)	Equal to background sound level, $L_{A90,T}$ (with consideration of context)	10 dB above background sound level, $L_{A90,T}$ (with consideration of context)
Night-time (2300-0700hrs)		

3.2 In instances where the predicted rating levels are between the LOAEL and the SOAEL thresholds, this can require some additional quantitative and qualitative considerations. Consideration must be given to the context within which the effect occurs in addition to employing professional judgement. These considerations can include:

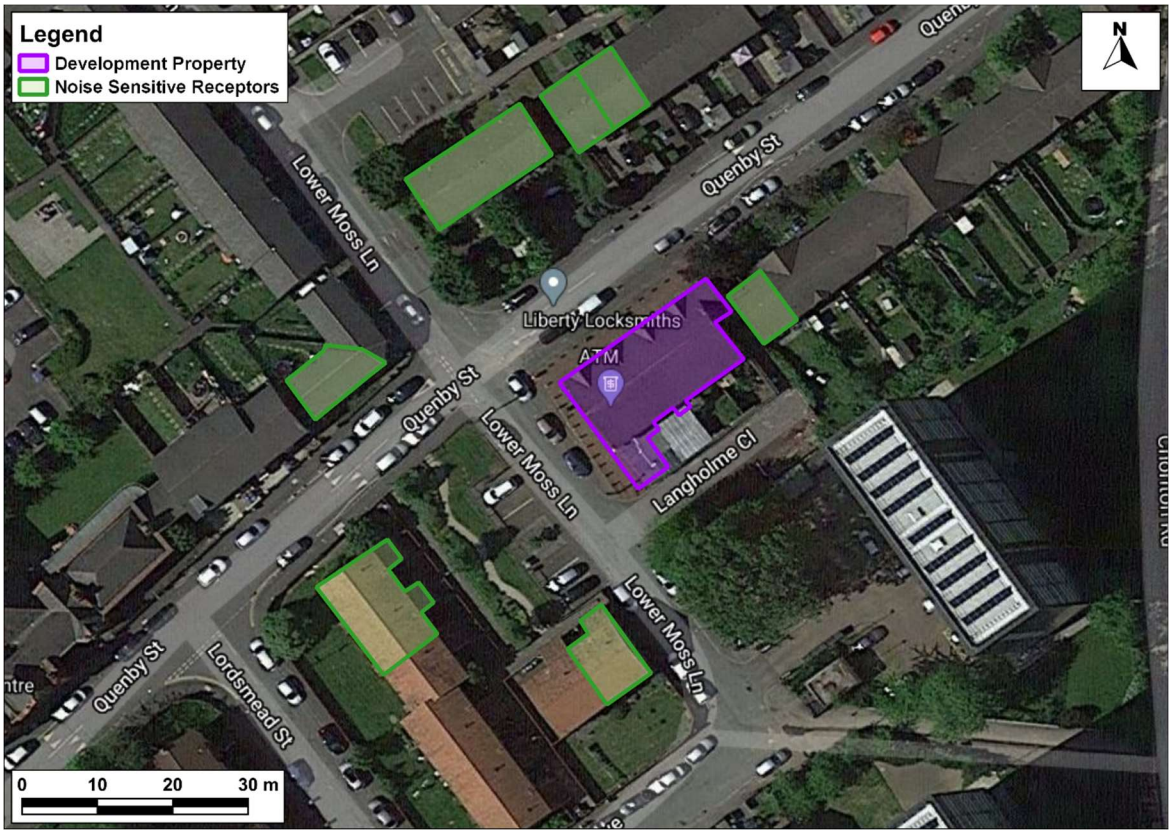
- the magnitude of the effect;
- the change in magnitude of the effect;
- the type of effect, including its intermittency;
- the existing ambient environment
- how effective the measures employed to mitigate the effect are, including Best Practicable Means (BPM); and
- the duration of the effect.

4 Assessment Approach

Noise Sensitive Receptors (NSRs)

4.1 The nearest NSRs in the vicinity of the proposed development are identified in **Figure 1**. The locations of the ASHPs are shown in **Appendix 8**.

Figure 1: Location of NSRs



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Sound Source Quantification - ASHP

4.2 Sound source information for a single ASHP is based on manufacturer's sound emission data for the units as presented in **Table 3**. Notably, sound power levels will vary and could be 5 to 10 dBA lower than those advised below when operated at lower levels of duty.

Table 3: Octave Band Sound Power Level (L_W) Data for Proposed ASHP Installation

Product and Mode of Operations	Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Panasonic WH-MDC05J3E5 (heating mode)	65	64	61	63	60	54	51	53	64[1]
Panasonic WH-MDC05J3E5 - WH-UD05JE5 (heating mode)	65	64	61	63	60	54	51	53	64[1]

Sound Source Modelling Methodology

4.3 The propagation of sound levels arising from the operation of the ASHP installation has adopted methodologies advocated within in ISO 9613-2:1996 '*Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation'* (ISO 9613-2, 1996).

4.4 It is assumed that the units run at full duty during the night-time. Importantly, because ASHPs are primarily used for heating, they would typically be used more during the winter months, when nearby residential receptors are likely to prefer to keep windows closed. It is assumed that where there is more than one ASHP, the installation operates at 50% load during the night-time.

4.5 Modelling was completed for several point receptors at 1 m distance from the façades of the NSRs. Noise contours were generated with 1 m grid resolution, and at a height of 4.5 m to represent the typical height of bedroom windows.

4.6 The results of the sound modelling exercise are shown visually in **Appendix A2**.

Baseline Sound Survey

4.7 A baseline sound survey was undertaken between 04:00 and 05:00 on 22nd January 2021. The survey was designed to capture the background (L_{A90}) sound levels at the quietest period of the night.

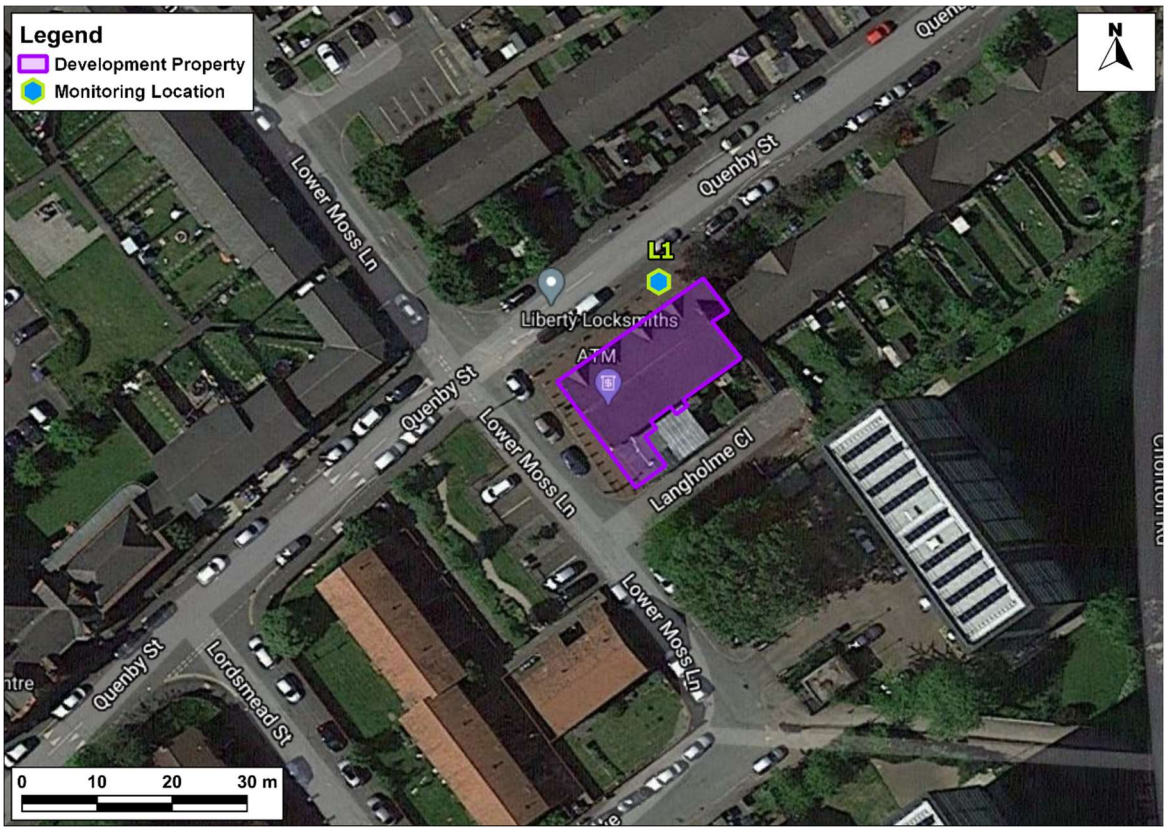
4.8 Attended measurements were taken during the night at locations in proximity to the proposed installation in order to obtain an understanding of prevailing baseline sound levels at nearby sensitive receptors (NSRs). **Figure 2** presents the location of the monitoring undertaken for the baseline sound survey.

[1] Measured according to EN12102-1 (7 °C air temperature and 55 °C water temperature) representing a worst-case compared to an assessment to EN-14825 which is represents a partial load / lower duty level.

4.9 Measurements were taken under free-field conditions (i.e. the sound level meter (SLM) was positioned at least 3.5 m from all surrounding reflective surfaces other than the ground).

4.10 The calibration levels of the SLM were checked before and after the measurement, with no significant drift in calibration levels recorded. Windshields were fitted to the microphones to minimise the effects of any wind induced sound.

Figure 2: Baseline Sound Survey Monitoring Locations



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4.11 All measurements were conducted, where possible, in accordance with BS 7445-1:2003 '*Description and measurement of environmental noise. Guide to quantities and procedures*' (BS 7445, 2003) and BS 4142:2014+A1:2019.

Survey Observations

4.12 The dominant contributor to the acoustic environment at the monitoring location was observed to be road traffic from the Deansgate Interchange network, particular the A5067 Chorlton Road and the A56 Chester Road. In terms of background (L_{A90}) sound levels these were considered to result from distant road traffic on the A5067 Chorlton Road and the A56 Chester Road as well as occasional distant rail traffic. Birdsong was also audible.

Meteorological Conditions During Survey

4.13 The weather conditions during the survey were clear with wind speeds less than 5 ms^{-1}. Some light precipitation occurred towards the end of the survey, and measurements recorded during this period were excluded from the results. The average temperature was 1 °C.

Survey Results

Baseline Sound Levels

4.14 A summary of the measured sound levels from the monitoring location is presented in **Table 4** (rounded to the nearest decibel). The background sound level ($L_{A90,T}$) presented has been used to inform the BS 4142:2014+A1:2019 assessment. The measured sound level is considered to be representative of the night-time period (23:00-07:00) for the purposes of the assessment.

Table 4: Measured Baseline Sound Levels

Location (see Figure 2)	Measurement Time	dB $L_{Aeq,T}$	dB $L_{A90,T}$
L1	Night-time (04:00 – 05:00 hrs)	52	43

5 Assessment of Development Impacts

5.1 The assessment has been undertaken in accordance with BS 4142:2014+A1:2019 methodology. Further details on this including consideration of character corrections is given in **Appendix A3**.

Assessment of Impacts

5.2 With reference to BS 4142:2014+A1:2019, the greater the rating level is above the background sound level, $L_{A90,T}$, the greater the significance of sound impact. An assessment of unmitigated ASHP sound emission at the worst affected receptor is presented in **Table 5**.

Table 5: BS 4142:2014+A1:2019 Assessment of Unmitigated ASHP Sound Emissions

Assessment Results	Night-time
Specific Sound Level dB $L_{Aeq,T}$ (free-field)	31
Tonality, dB	0.0
Impulsivity, dB	0.0
Intermittency, dB	+3.0
Other sound characteristics, dB	0.0
Rating Level calculated at the closest receptor point rounded to nearest dB, dB $L_{Ar,Tr}$	34
Background Sound Level, dB L_{A90}	43
Rating Level – Background Sound Level	-9
BS 4142:2014+A1:2019 Outcome	Indication of Low Impact depending on the context

5.3 The BS 4142:2014+A1:2019 assessment has shown an outcome of 'Indication of Low Impact depending on the context', which is below the LOAEL with reference to **Table 2**.

5.4 It is considered likely that there will be some variation in the operational periods that the ASHPs will operate. It is likely that they will predominantly operate in colder months when windows are closed, hence reducing any potential adverse impacts. Like domestic boilers, it is expected that most people would turn their heating off at night therefore it is reasonable to assume that they are less likely to be used at night. It is considered that impacts would be lower during the daytime than at night due to elevated background sound levels during the daytime.

6 Conclusion

6.1 Noise Consultants Ltd (NCL) has been instructed to carry out an assessment to identify the potential effects of sound at the nearest noise sensitive receptors (NSRs) resulting from an Air Source Heat Pump (ASHP) installation at 43 Quenby St, Manchester (M15 4HX).

6.2 This report presents the findings of a baseline sound survey and the results of an assessment of noise impacts resulting from the proposed installation. This report has been prepared in accordance with National legislation, policies, and guidance and by reference to appropriate British and International standards.

6.3 Predictions of sound levels from the proposed ASHP installation at the NSRs based on manufacturer's sound emission data for the units. An assessment has been conducted in accordance with BS 4142:2014+A1:2019 which provided an 'Indication of Low Impact depending on the context'. On this basis no further mitigation is required for the proposed installation.

6.4 On the basis of this assessment, the development is not considered likely to give rise to a significant adverse impact on health and quality of life in relation to noise, in accordance with paragraph 170 and 180 of the NPPF.

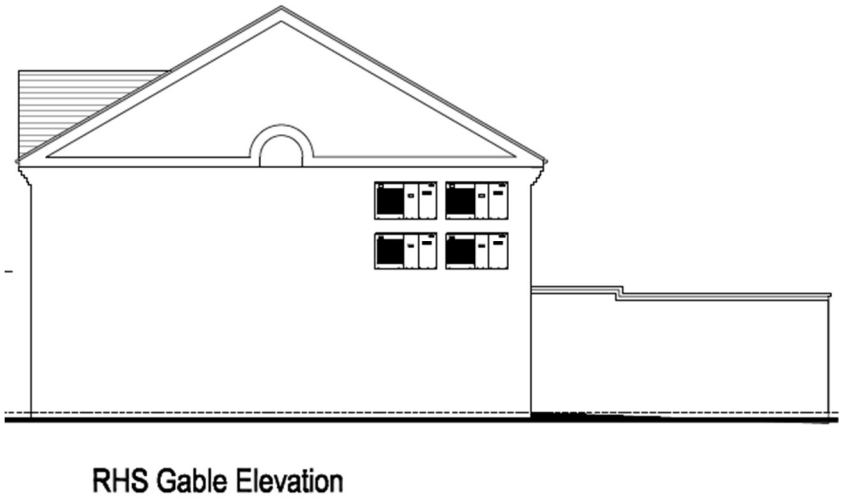
7 Glossary

dB	Decibel. The logarithmically scaled measurement unit of sound.
A-weighting	Frequency weighting applied to measured sound in order to account for the relative loudness perceived by the human ear.
$L_{Aeq,T}$	A-weighted equivalent continuous sound level over a given time period. It is the sound level of a steady sound that has the same energy as a fluctuating sound over the same time period.
$L_{A10,T}$	The A-weighted sound level exceeded for 10% of the measurement period. It is widely used as a descriptor of road traffic noise.
$L_{A90,T}$	The A-weighted sound level exceeded for 90% of the measurement period. Often referred to as the background sound level.
L_{Amax}	The A-weighted maximum recorded noise level during a measurement period.
Ambient sound level, $L_a = L_{Aeq,T}$	The A-weighted equivalent continuous sound level of the totally encompassing sound for a given situation and time interval, T.
Residual sound level	The A-weighted equivalent continuous ambient sound level remaining when the specific sound level has decreased to a degree in which it does not contribute to the ambient sound level.
Specific sound level, $L_s = L_{Aeq,Tr}$	The A-weighted equivalent continuous sound pressure level produced by the specific sound source at the reference location over a reference time interval, T
Rating level, $L_{Ar,Tr}$	The specific sound level plus any adjustment for the characteristic features of the sound.

8 Appendices

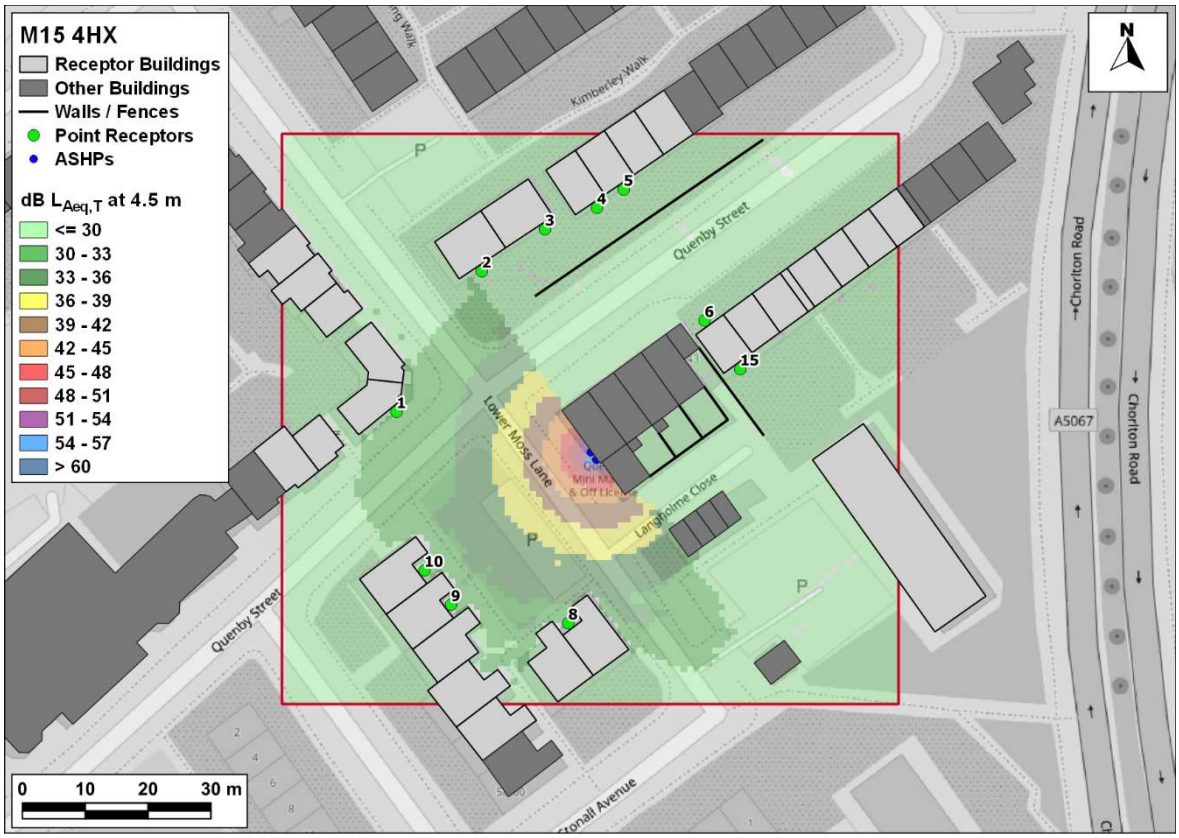
A1 Locations of Proposed ASHPs

Figure A.1.1: Proposed locations of the ASHPs



A2 Sound Modelling Results

Figure A.2.1: Sound Modelling Results



A3 Assessment Procedure

Residential Receptors

BS 4142:2014+A1:2019 Procedure

A3.1 The basic procedure of a BS 4142:2014+A1:2019 assessment is to compare the operational sound level from the source(s) at the assessment location(s) (the specific sound level, L_s) with the existing acoustic environment, (background sound level, $L_{A90,T}$).

A3.2 The assessment is performed by comparing the rating level of the sound source(s), $L_{Ar,Tr}$, at the worst affected receptor against the background sound level, $L_{A90,T}$. The background sound level should be measured during a period in absence of the influence of sound from the industrial sources. Guidance is provided on how to monitor and determine the background sound level, specific sound level and rating level.

A3.3 Where there are certain acoustic features of the specific sound level, L_s that would likely increase the significance of impact, then an appropriate character correction is added to the specific sound level, L_s. This is referred to as the rating level $L_{Ar,Tr}$.

Character Correction Considerations

Tonality

A3.4 A tonal correction between 0 and +6 dB can be applied for sounds that range from not tonal to prominently tonal. Several methodologies are presented in BS 4142:2014+A1:2019 in order to determine the appropriate correction to be applied. **Table A.3.1** presents the subjective assessment method corrections for tonal sounds.

Table A.3.1: Subjective Method – Rating Level Corrections for Tonal Sounds

Subjective assessment of sound source at the receptor	Correction
The tone is just perceptible at the receptor	+2 dB
The tone is clearly perceptible at the receptor	+4 dB
The tone is highly perceptible at the receptor	+6 dB

A3.5 The objective method for determining a tonal penalty is described in Annex C of BS 4142:2014+A1:2019, which defines the level differences between adjacent one-third-octave bands that identify a tone as:

- 15 dB in the low-frequency one-third octave bands (25 Hz to 125 Hz);
- 8 dB in the middle-frequency one-third octave bands (160 Hz to 400 Hz); and

- 5 dB in the high-frequency one-third octave bands (500 Hz to 10,000 Hz).

A3.6 For this assessment it is assumed that the ASHP is not tonal.

Impulsivity

A3.7 An impulsivity correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level.

A3.8 **Table A.3.2** presents the subjective method corrections for impulsive sounds.

Table A.3.2: Subjective Method – Rating Level Corrections for Impulsive Sounds

Subjective assessment of sound source at the receptor	Correction
Impulsivity is just perceptible at the receptor	+3 dB
Impulsivity is clearly perceptible at the receptor	+6 dB
Impulsivity is highly perceptible at the receptor	+9 dB

A3.9 The sound emissions of the proposed ASHP do not include impulsive characteristics, therefore no penalty has been considered appropriate to be applied to the assessment.

A3.10 For this assessment it is assumed that the ASHP is not impulsive.

Intermittency and Other Sound Characteristics

A3.11 Where the specific sound level features characteristics that are neither tonal nor impulsive, though otherwise are of an intermittent character, a penalty of +3 dB can be applied. Assuming that the proposed plant items are kept well maintained and serviced regularly, no further penalties are required for this assessment.

A3.12 For this assessment it is assumed that the ASHP exhibits a degree of intermittency, therefore a +3 dB penalty has been applied.

Reference Time Periods

A3.13 The appropriate reference time interval for assessing a sound source is dependent upon when it operates i.e., during the daytime or night-time. BS 4142:2014+A1:2019 determines the reference time interval as 1 hour during the day and 15 minutes at night. As the ASHP will operate relatively consistently over these time intervals a night-time (23:00 – 07:00) assessment has been undertaken as a worst case when the measured background sound levels are lowest.

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