

POST COMPLETION ASSESSMENT

CLIENT
WILES & MAGUIRE LIMITED
Old Stationmasters House
Liverpool Road
Manchester
M3 4FP

31 MAY 2024

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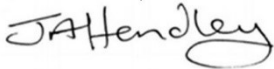
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Document Control

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CLIENT	WILES and MAGUIRE LIMITED	
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PREPARED BY		James Hendley AMIOA Acoustic Consultant
CHECKED BY		

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1 Introduction

AEI Acoustics Limited have been appointed by Wiles and Maguire Limited to undertake a Post Completion Assessment following the conversion of the Old Stationmasters House, Liverpool Road, Manchester M3 4FP, from existing office spaces to holiday let accommodation.

The Post Completion Assessment has been commissioned by Wiles & Maguire Limited in response to the request by the local planning authority (LPA) and in accordance with the Environmental Noise Assessment (ENA001_1038_JH_Rev C) issued and accepted by the local authority.

The criteria received states that....” The scheme shall be implemented in full before the first occupation of the development.

b) Prior to the first occupation of the development, a verification report shall be submitted to and approved in writing by the City Council as local planning authority to validate that the work undertaken throughout the development conforms to the recommendations and requirements in the approved acoustic report. The report shall also undertake post completion testing to confirm that the noise criteria have been met. Any instances of non-conformity with the recommendations in the report shall be detailed along with any measures required to ensure compliance with the agreed noise criteria. These mitigation measures will be implemented in full prior to first occupation.”

A baseline noise survey (unattended) was carried out between 24th May 2024 and the 27th May 2024, from two measurement positions, to establish typical internal noise levels within a ground floor and second floor bedroom. A further assessment based on a one-hour measurement period was conducted to assess the noise impact of the two air source heat pumps (ASHP's) and was undertaken on the 24th May 2024.

2 Assessment Criteria

2.1 BS4142:2014 Methods for rating and assessing industrial and commercial sound.

- 2.1.1 BS 4142:2014 was published in October 2014 and has superseded the previous 1997 version. The document presents methods for rating and assessing the potential impact of commercial and industrial sound upon noise sensitive receptors.
- 2.1.2 The 2014 edition of BS 4142 is entitled 'Methods for rating and assessing industrial and commercial sound' which differs slightly to the former 1997 version of BS 4142 which was entitled 'Method for rating industrial noise affecting mixed residential and industrial areas'. The 2014 version clearly differentiates the use of the terms 'sound' and 'noise'. The foreword to the new version explains that:

'response to sound can be subjective and is affected by many factors, both acoustic and non-acoustic. The significance of its impact, for example, can depend on such factors as the margin by which a sound exceeds the background sound level, its absolute level, time of day and change in the acoustic environment, as well as local attitudes to the source of the sound and the character of the neighbourhood. This edition of the standard recognizes the importance of the context in which a sound occurs.....sound can be measured by a sound level meter or other measuring system. Noise is related to a human response and is routinely described as unwanted sound, or sound that is considered undesirable or disruptive'.

- 2.1.3 The scope of BS 4142 has been broadened to provide a method for rating and assessing sound of an industrial and/or commercial nature. The scope now specifically includes sound from industrial and manufacturing processes, sound from fixed plant, sound from loading and unloading of goods at industrial and commercial sites and mobile plant forming an intrinsic part of the overall sound from a premises or process.
- 2.1.4 Guidance now introduces the concept of 'context' to the process of identifying noise impact. Section 11 of BS 4142:2014 explains that:

'The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs (my emphasis). An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context.'

- 2.1.5 It is therefore entirely possible that whilst the numerical outcome of a BS 4142 assessment is indicative of adverse or significant adverse impact, when the proposal is considered in context the significance of the impact is reduced to an acceptable level. However, the opposite may also be true. There are many context points to consider when undertaking an assessment of sound impact including:

- The absolute level of sound.
- The character and level of the specific sound in the context of the existing noise climate. For instance, is the sound occurring in a location already characterized by similar activities as those proposed?
- The sensitivity of the receptors.
- The time and duration that the specific sound is to occur.
- The conclusions of assessments undertaken using alternative assessment methods, for example WHO guidelines noise values or change in noise level.

- The ability to mitigate the specific sound through various methods, for example by screening, the selection of quiet plant equipment, the use of attenuators and louvres, through the imposition of noise management plans and good practice, façade design and layout/orientation.
- The form and scale of a development. For example, does the proposed development involve new industrial or commercial premises being built or is the proposal the installation of new plant or an extension to an existing premises?

2.1.6 The comparison of the 'Rating level' with the 'Background **sound** level' in the BS 4142 assessment methodology is retained, however new acoustic feature corrections are incorporated to determine the rating level. Whereas previously the methodology allowed for the addition of a single 5 dB correction (to account for acoustic features such as tonality, impulsiveness or if the noise was irregular enough to attract attention) it now allows up to 6 dB to be added to the specific sound level for tonality, with an additional correction of 3 dB for intermittency or up to 9 dB to be added depending on the degree of impulsivity. All these corrections can be added together in linear fashion where appropriate. Where the source is neither tonal nor impulsive but that a feature characteristic is present that makes the sound source readily distinctive a correction of 3 dB can be added. Hence under the latest methodology noise sources that would formerly have only been corrected by up to 5 dB (using BS 4142:1997), may now be corrected by up to 15 dB which could significantly influence the outcome of the assessment.

2.1.7 To assess the impact, the 'Rating level' of the new noise source is compared with the existing 'Background level' and the following analysis made:

- Typically, the greater this difference, the greater the magnitude of the 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.
- 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.

2.1.8 BS 4142 requires separate analysis for day and night-time periods. For the assessment of noise impacts, BS 4142 advises evaluating the specific sound over an appropriate reference time interval (T_r) of:

- 1 h during the day (between 07:00 to 23:00 hours); and
- 15 min during the night (between 23:00 to 07:00 hours).

2.1.9 Additionally, the assessment methodology now requires that the issue of uncertainty be taken into consideration. The document explains how to reduce the element of uncertainty through good practice but is unclear on how one determines a numerical value to place on uncertainty.

2.2 BS8233: 2014 – Guidance on sound insulation and noise reduction for buildings

- 2.2.1 BS8233:2014 provides guidance on sound reduction with buildings by providing appropriate levels of noise within dwellings, flats and rooms for residential use.
- 2.2.2 Section 7.2.2 'Internal ambient noise levels in dwellings' of BS8233:2014 states that the desired internal ambient noise levels do not exceed guideline values as shown in Table 4 below:

Table 4 Indoor ambient noise levels for dwellings

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	—
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	—
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

Image 1: Table 4 from BS8233:2014

- 2.2.3 Section 7.2.2, Note 7 also states that the guideline internal target levels (see table 4 above) may be relaxed by up to 5dB from those shown and still meet reasonable internal conditions to those deemed as necessary or desirable by the World Health Organization (WHO)
- 2.2.4 Paragraph 8.2 of BS8233:2014 refers to flanking transmission and the need to ensure care is taken at all stages to ensure the control of noise issues due to flanking transmission is controlled effectively. The three areas for consideration should include:
- Junction detail between the separating wall/ floor and the flanking wall;
 - Mass of flanking elements;
 - Transmission through floor voids, loft spaces, service ducts, mullions and similar paths
- 2.2.5 BS8233:2014 offers additional information on various building elements and the general anticipated effectiveness of these construction methods.

2.3 Guidelines for Community Noise (World Health Organisation [WHO], 1999)

- 2.3.1 Published in 1999, the World Health Organisation highlighted environmental noise as one of the largest contributors to health issues. Guidelines for Community Noise included guideline values based on L_{Aeq} values for daytime periods (07.00 to 23.00) and night-time periods (23.00 to 07.00).
- 2.3.2 Table 1 below is extracted from Guidelines for Community Noise (Table 4.1) and based on specific environments for residential purposes.

Specific Environment	Critical Health Effect(s)	L_{Aeq} [dB]	Time Base (hours)	$L_{Amax,fast}$ [dB]
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, Indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60

Table 1: Extract from Table 4.1: Guidelines for Community Noise

2.4 Noise Policy Statement for England (NPSE)

2.4.1 Noise Policy Statement for England¹ (NPSE) sets out the long-term vision of promoting good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development. This long-term vision is supported by the following aims:

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

2.4.2 NPSE describes the following levels at which noise impacts may be identified:

- **NOEL** – No Observed Effect Level. This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
- **LOAEL** – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected.
- **SOAEL** – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.

2.4.3 According to the explanatory notes in the statement, where a noise level falls between the lowest observable adverse effect level (LOAEL) and a level which represents a significant observable adverse effect level (SOAEL):

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

2.5 National Planning Policy Framework (NPPF) December 2023

2.5.2 The National Planning Policy Framework (NPPF) set out the Government’s planning policies for England and how they are expected to be applied. It provides a framework within which the Local Authorities are to prepare local plans and use their planning powers to minimise the adverse impact of noise. It should contain the following in relation to noise impacts.

2.5.3 Paragraph 180 (e) states “Planning policies and decisions should contribute to and enhance the natural and local environment by”:

‘(e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability.....’

2.5.4 Paragraph 191 (a) states “Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should”:

‘(a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life’

¹ Government Department for Environment, Food and Rural Affairs. Noise Policy Statement for England. March 2010.

2.6 Noise Exposure Hierarchy Table

2.3.1. Table 2 below summarizes the noise exposure hierarchy based on the likely average response of those affected.

Response	Examples of Outcomes	Increasing effect level	Action
No Observed Effect level (NOEL)			
Not Present	No effect	No observed effect	No specific measures required
No Observed Adverse Effect Level (NOAEL)			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level (LOAEL)			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

Table 2: Noise Exposure Hierarchy

3 Site Description

The Old Stationmasters House is situated on the junction of Water Street and Liverpool Road, Manchester M3 4FP. The property is set close both busy road and rail networks. There is a mix of commercial and residential properties within a radius of (up to) 67 metres from the ASHP's.



Image 2: Ariel View of The Old Stationmasters House and surrounding area (Courtesy of Google)

The approximate distances of the source from noise sensitive receivers are:

- 33 metres to the closest residential property to the south.
- 67 metres to the closest commercial property (Aviva Studios) to the north

Three s The ASHP's are located facing towards a closed tunnel forming part of the overhead bridge and closed off at the far end with a lightweight timber frame and plywood structure.



Image 3: ASHP's from inside the arch



Image 4: Access to arch/ ASHP's



Image 5: View into arch from ASHP's



Image 6: Site survey overview (courtesy of Google)

The new ASHP's have been sited in a position shielded by existing barriers (buildings, bridges and other features) from both existing residential and commercial properties.

The internal features of the Old Stationmasters House have been refurbished in a sympathetic way that meets the historic and heritage associated with the existing building including replacement windows supplied by Mumford & Wood.



Image 7: External view



Image 8: View from second floor of ASHP's



Image 9: Ground floor bedroom

4 Survey Information

4.1 Instrumentation

4.1.1 The following measurement instrumentation was used to record the representative noise data, as follows:

Equipment	Manufacturer & Type	Serial Number	Calibration Certificate	Calibration Date	Calibration due
Data Logger #1	Svantek SV 307A	116168	1502949-1	03/08/2022	03/08/2024
Data Logger #2	Sound Level Meter Type CR:811B	C17352FD	U41458	11/07/2022	11/07/2024
Acoustic Calibrator	Cirrus 511E Class 1	036345	1506397-3	18/09/2022	18/09/2024

Table 3: Measurement Equipment Information

4.1.2 In accordance with the requirements of BS4142: 2014 the sound level meter was calibrated before and after each measurement session (clause 6.1) with an approve Class 1 acoustic field calibrator (114 dB). The details are shown below in Table 4.

Equipment	Drift Before (dB)	Drift After (dB)
Svantek 307A	0.02	0.02
Cirrus CR:811B	0.3	0.3

Table 4: Field Calibration Data

4.2 Survey Period and Measurements

- 4.2.1 The unattended survey for internal noise levels in the bedrooms was undertaken over a period between 24th May (starting at 11.45) to 27th May 2024 (finishing at 09.00), which included a weekend and a bank holiday
- 4.2.2 An additional measurement was taken on the 24th May 2024 to measure the noise levels generated by the ASHP's. This was over a one hour period between 10.45 and 11.45.
- 4.2.3 Three separate measurement positions were used as follows:
- MP1 – Air Source heat Pumps
 - MP2 – Ground floor corner bedroom
 - MP3 – Second floor corner bedroom
- 4.2.4 Given the size of the rooms the sound level meters were placed in a central location to reduce the impact of reflections from the walls, floor and ceiling.
- The microphone height was set at 1.5 metres from floor level and at a minimum of 1.8 metres from any wall.



Image 10: SLM position for MP2 (left) and MP3 (right)

- 4.2.5 The measurement for the air source heat pump assessment was undertaken at a distance of 3 metres from the ASHP's. This placed the sound level meter approximately 2.5 metres into the arched area, 2.5 metres from each wall and the microphone 1.8 metres from floor level. The rear of the arch is approximately 12.91 metres from MP1 and consisted of a lightweight timber stud and plywood wall.



Image 11: Measurement Position 1 (MP1)

- 4.2.6 Predictive calculations to the closest noise sensitive receptor (NSR1) have been included to provide key acoustic data and appropriate sound levels at noise sensitive receptor. The calculations used may consider factors such as ground effect, barriers, distance, and directivity.
- 4.2.7 Measurement periods are classified as daytime (07.00 to 23.00) and nighttime (23.00 to 07.00)
- 4.2.8 Measurements reported on are $L_{Aeq,T}$, $L_{A90,T}$ and $L_{Amax,T}$ and in accordance with BS7445: Parts 1 & 2.
- 4.2.9 Unless stated all sound pressure levels are shown in decibels (dB) (re $20\mu Pa$)

4.3 Meteorological Conditions

- 4.3.1 The unattended measurements are unaffected by weather given they are representative of internal noise levels being monitored.
- 4.3.2 During the shorter attended measurement period for the ASHP's the following weather conditions were noted (see table 5 below).

Date	Weather	Temp (°C)	Wind (mph)
24 th Nov	Wet following heavy rain, cloudy and dry	14	3

Table 5: Weather conditions for 24.05.24

5 Noise Survey Results

5.1 Noticeable Acoustic Characteristics

5.1.1 Characteristics that make up the overall ambient noise level come from a wide variety of sources including:

- Rail noise from overhead network
- Road traffic from Liverpool Road and Water Street
- Emergency service sirens
- Vehicle reversing beacons

5.2 Measurement Data

5.2.1 The information shown in table x below summarizes the data collected for each of the measurement positions.

MEASUREMENT POSITION 1 (MP1) – ASHP						
Date	Period	Duration	L _{A90,T} Min (dB)	L _{A90,T} Max (dB)	L _{A90,1hour} (dB)	L _{Aeq,T} (dB)
24.05.24	10.45-11.45	1 hour	43.4	61.5	46.2	53.8

Table 6: MP1 Measurement data

MEASUREMENT POSITION 2 (MP2) – GROUND FLOOR					
Date	Period	Duration	L _{Aeq,T} (dB)	L _{AFmax,T} (dB)	L _{AFmax,T} >45 dB
24.05.24	10.00-23.00	13 hours	40.7		
24.05.24	23.00-07.00	8 hours	28.1	61.9	18
25.05.24	07.00-23.00	16 hours	32.1		
25.05.24	23.00-07.00	8 hours	28.5	69.2	14
26.05.24	07.00-23.00	16 hours	31.7		
26.05.24	23.00-07.00	8 hours	28.5	69.2	11
26.05.24	07.00-09.30	2.5 hours	32.6		

Table 7: MP2 Measurement data

MEASUREMENT POSITION 3 (MP3) – SECOND FLOOR					
Date	Period	Duration	L _{Aeq,T} (dB)	L _{AFmax,T} (dB)	L _{AFmax,T} >45 dB
24.05.24	12.00-23.00	11 hours	26.4		
24.05.24	23.00-07.00	8 hours	30.0	56.7	13
25.05.24	07.00-23.00	16 hours	32.4		
25.05.24	23.00-07.00	8 hours	30.0	66.6	10
26.05.24	07.00-23.00	16 hours	33.5		
26.05.24	23.00-07.00	8 hours	30.2	66.6	9
26.05.24	07.00-09.30	2.5 hours	30.4		

Table 8: MP3 Measurement data

5.2.2 Key points taken from the measurement data above (tables 6 -8):

- The noise level of the ASHP's operating at a distance of 3 metres is masked by the background noise levels.
- Spikes in $L_{Amax,T}$ noise levels are associated to loud events connected to motor vehicles accelerating and/ or fitted with modified exhaust systems (nighttime periods only)
- Nighttime measurements are based on closed windows with ventilation provided by other means as per the Environmental Noise Assessment provided for the planning stages.
- Ground floor L_{Amax} levels are between 3 – 5 dB higher on the ground floor indicating that road traffic or pedestrian noise would be the most probable source.

6 Noise Assessment

6.1 BS4142:2019 Assessment (Air Source Heat Pumps)

- 6.1.1 Assessment is based on day and night time periods.
- 6.1.2 Based on a 1 hour measurement period where both units are in operation at the same time.
- 6.1.3 Measured Background Noise Levels ($L_{A90,T}$) are based on those originally recorded for the Environmental Noise Assessment carried out in November 2022.
- 6.1.4 Background noise levels (L_{A90}) measured at MP1 would not be representative of levels at NSR1 given that they are dominated by plant noise levels.
- 6.1.5 Ambient sound level is the overall level measured that includes the impact with the source active (specific sound level) and inactive (residual sound level)
- 6.1.6 The rating includes any adjustment for acoustic features such as distance and barrier attenuation that may impact on the levels at the noise sensitive receptor.
- 6.1.7 Distance attenuation is based on the inverse square law that states that sound propagation will decay at a rate of 6 dB per doubling of distance for a spherical point source.
- 6.1.8 Barrier attenuation is based on ISO 9613-2 Acoustics – Attenuation of sound during propagation outdoors and calculated using Maekawa formula, shown below:

$$\text{Barrier Attenuation} = 10 \log (3 + 20N) \text{ dB}$$

Where N is a Fresnel number based on the path difference and wavelength ($N = 2\delta/\lambda$), δ is the path difference and λ the wavelength.

BS4142 ASSESSMENT FOR A REPRESENTATIVE DAY TIME PERIOD (RESIDENTIAL RECEIVER)		
Parameter	Value/Outcome	Notes
Measured Ambient Sound Level	54 dB $L_{Aeq,16\text{hours}}$	See table 6
Residual Sound Level	52 dB $L_{Aeq,T}$	Taken from time history when ASHP not running
Typical Background Sound Level	46 dB $L_{A90,T}$	See table 6
Specific Sound Level	50 dB $L_{Aeq,1\text{hour}}$	Determined by logarithmic subtraction of residual noise level from ambient noise level. $L_S = 10\log(10^{L2/10} - 10^{L1/10})$
Distance Attenuation	21 dB	See 9.2 33 metres from source to receiver
Barrier Attenuation	25 dB	See 9.1 Maximum permissible level based on ISO 9613-2
Acoustic Feature Correction	+3 dB Intermittently	Given nature of ASHP operation
Rating Level	$(50 + 3) - 46 = 7$ dB $L_{Ar,Tr}$	Specific Sound plus Acoustic Feature Correction minus Distance and Barrier Attenuation
Excess of rating over Background Sound Level	- 39 dB	Rating Level minus Background Sound Level
Assessment	LOW ADVERSE IMPACT	

Table 9:BS4142 for daytime period (ASHP-Residential)

BS4142 ASSESSMENT FOR A REPRESENTATIVE NIGHT-TIME PERIOD (RESIDENTIAL RECEIVER)		
Parameter	Value/Outcome	Notes
Measured Ambient Sound Level	55 dB $L_{Aeq,8hours}$	Based on previous survey undertaken in 2022
Residual Sound Level	52 dB $L_{Aeq,T}$	Taken from time history when ASHP not running
Typical Background Sound Level	42 dB $L_{A90,T}$	Based on levels measured during previous survey in 2022
Specific Sound Level	52 dB $L_{Aeq,8hours}$	Determined by logarithmic subtraction of residual noise level from ambient noise level. $L_S = 10\log(10^{L_{2/10}} - 10^{L_{1/10}})$
Distance Attenuation	21 dB	See 9.2 33 metres from source to receiver
Barrier Attenuation	25 dB	See 9.1 Maximum permissible level based on ISO 9613-2
Acoustic Feature Correction	+3 dB Intermittently	Given nature of ASHP operation
Rating Level	$(52 + 3) - 46) =$ 9 dB $L_{Ar,Tr}$	Specific Sound plus Acoustic Feature Correction minus Distance and Barrier Attenuation
Excess of rating over Background Sound Level	- 33 dB	Rating Level minus Background Sound Level
Assessment	LOW ADVERSE IMPACT	

Table 10: BS4142 for nighttime period (ASHP-Residential)

BS4142 ASSESSMENT FOR A REPRESENTATIVE NIGHT-TIME PERIOD (COMMERCIAL RECEIVER)		
Parameter	Value/Outcome	Notes
Measured Ambient Sound Level	55 dB $L_{Aeq,8hours}$	Based on previous survey undertaken in 2022
Residual Sound Level	52 dB $L_{Aeq,T}$	Taken from time history when ASHP not running
Typical Background Sound Level	46 dB $L_{A90,T}$	See table 6
Specific Sound Level	52 dB $L_{Aeq,8hours}$	Determined by logarithmic subtraction of residual noise level from ambient noise level. $L_S = 10\log(10^{L_{2/10}} - 10^{L_{1/10}})$
Distance Attenuation	27 dB	See 9.2 67 metres from source to receiver
Barrier Attenuation	0 dB	No barrier allowed for although structures such as bridges may offer some sound reduction benefits
Acoustic Feature Correction	+3 dB Intermittently	Given nature of ASHP operation
Rating Level	$(55 + 3) - 27) =$ 31 dB $L_{Ar,Tr}$	Specific Sound plus Acoustic Feature Correction minus Distance and Barrier Attenuation
Excess of rating over Background Sound Level	- 15 dB	Rating Level minus Background Sound Level
Assessment	LOW ADVERSE IMPACT	

Table 11: BS4142 for daytime (ASHP-Commercial)

- 6.1.9 Both the day and night-time periods must be taken with the context under which they operate and have been assessed on.

At a distance of 3 metres the operating state is difficult to isolate from background noise levels measured. The distance between source and receiver without the building acting as a barrier would be sufficient for the affect of the ASHP's on the residents to be unnoticeable.

- 6.1.10 Additionally these periods also have a degree of uncertainty associated with them. Such degrees of uncertainty include:

The background noise levels are representative of the activity in the area at the time of the survey and may fluctuate depending on circumstance and changes in and around the area. It also assumes that the anti-vibration mounts fitted do not degrade and the equipment is maintained in a fit and proper state.

- 6.1.11 No additional mitigation is required for either noise sensitive receiver given the measured sound levels, distance factor and barrier effect (for the residential receiver)

6.2 BS8233:2014 Assessment

- 6.2.1 Referring back to table 6 the assessment shows that:

- a) Internal day time noise levels are below the $L_{Aeq,T}$ 35 dB criteria required.
- b) Internal night time noise levels are equal to or below the $L_{Aeq,T}$ 30 dB criteria required.
- c) L_{Amax} levels exceed the internal night time levels of 45 dB however given the proximity of the road network to the bedrooms this would be expected.

- 6.2.2 The majority of L_{Amax} levels exceeded can be associated to motor vehicles accelerating at speed and at least on one occasion as a result of a 'popping' modified exhaust system.

- 6.2.3 The new timber framed sash windows that have been fitted are based on the following specification with sealed glazing units (4mm Toughened Low E Glass / 6mm Air Space with Krypton gas / 4mm Toughened Low E Glass).

- 6.2.4 The rooms have been fitted with partial wooden shutters internally however these would offer no benefit for reducing external noise levels.

- 6.2.5 Additional mitigation may be possible through the introduction of a secondary glazed unit being fitted internally. The benefits of such system will vary depending on the style and specification chosen.

7 Conclusions

AEI Acoustics Limited has been commissioned to undertake a post completion assessment for the refurbished Old Stationmasters House, Liverpool Road, Manchester M3 4FP. This is based on the measurements taken during the survey conducted between 24-27 May 2024 and the Environmental Noise Assessment undertaken 25-28 November 2022 as part of the planning application process (ENA001_1038_JH_Rev C)

Internal noise levels are as expected based on the those predicted in the initial Environmental Noise Assessment and the survey undertaken as part of this report with windows in a closed state. The $L_{Aeq,T}$ levels meet the expectations of BS8233:2014 for bedrooms during the day and nighttime period however the L_{Amax} events exceed the required number on a few occasions as a result of road traffic.

As per the Environmental Noise Assessment (section 7.7) *'The nature of the site does not allow for this to be mitigated and therefore whilst windows may still be openable, other means of ventilation, to reduce overheating, may need to be explored.'*

The BS4142 rating of **low adverse impact** was calculated based on the both the chosen residential and commercial noise sensitive receivers, taking into account distance and barrier effect offered by the Old Stationmasters building (for residential receiver only).

In all instances the rating shows a level at the receiver in excess of 20dB below the background noise levels (L_{A90}) measured during both surveys undertaken either as part of the planning application or post completion assessments.

The external element (air source heat pumps) require no further mitigation based on the measurements and assessment carried out. Internal noise levels may be reduced further by the introduction of secondary glazing however the benefits would need to be assessed to determine the effectiveness and cost implications.

8 Glossary of Terms

Background Noise (L_{90})

This is a statistical parameter often used to identify levels of background noise based on the noise levels measured and exceeded for 90% of the time.

Decibel (dB)

This is the main unit used to measure sound. It is a logarithmic unit used to express the magnitude of sound, changes in sound levels and a measure of sound insulation.

A Weighting (dBA)

This is the measure of sound that has been adjusted using the A-weighted spectrum that modifies the measured data to compensate for the sensitivity of the human ear.

C Weighting (dBC)

This is the measure of sound that has been adjusted using the C-weighted spectrum that modifies the measured data to compensate for very loud noises and aircraft.

Fast (F) Time Weighting

An averaging time used in sound level meters, as defined in BS EN ISO 61672-1

$L_{Aeq,T}$

This is the 'equivalent continuous A-weighted sound pressure level, in decibels', and is defined in British Standard BS 7445 as the *"value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, T, has the same mean square sound pressure as a sound under consideration whose level varies with time"*. It is a unit commonly used to describe construction noise, noise from industrial premises and is the most suitable unit for the description of many other forms of environmental noise.

L_{AFmax}

The $L_{Amax,f}$ is the maximum sound pressure level, measured over the measurement period, using a 'fast' time weighting.

$L_{Ar,Tr}$

The $L_{Ar,Tr}$ is the specific noise level of a source, plus any adjustment for characteristic features of the noise, determined for the reference time interval. It is also known as the rating level.

Noise

Noise is defined as sound which is unwelcome and can cause distress, annoyance or disturbance to unwilling listeners.

Noise Annoyance

Noise annoyance can be defined as a stress reaction to a noise source that gives a feeling of displeasure associated with it.

Noise Nuisance

Noise emitted from premises so as to be prejudicial to health or well being of others that may be affected by these emissions through substantial interference on the owner or occupier of a space.

Octave Band

The frequency range divided into bands that allow for a manageable method of analysing data. Human hearing ranges from 20Hz to 20kHz.

One Third Octave Bands

These are octave bands that have been further divided into 3 separate bands. For example 125Hz octave band divides into one third octave bands of 100Hz, 125Hz and 160Hz

Reverberation

The effect of sound waves bouncing off of hard reflective surfaces resulting in a build-up of overlapping sound waves. Reverberation time is measured in seconds and calculated based on the time it takes for the level to decay by 60 dB once the noise source has been turned off.

Sound Power Level (SWL, L_w)

The sound energy radiated per unit of time by a sound source and expressed in decibels. Sound Power Levels do not change in relation to the receiver and the source.

Sound Pressure Level (SPL, L_p)

The physical measurement of sound energy radiated by a source noise and expressed in decibels. Sound Pressure Levels do change in relation to the receiver to the source and other environmental effects such as ground or barriers.

Sound Reduction (R_w)

The laboratory measured value in how much a partition or barrier will effectively reduce the passage of sound through the element.

9 Appendices

9.1 Barrier attenuation Calculations

Element	Ref	Distance (m)								
Source Height	S	1.200								
Receiver Height	R	8.000								
Barrier Height	B	12.000								
Source to 1st diffraction Point	d_{ss}	10.804								
Distance between diffraction points	e	1.000								
2nd diffraction point to receiver	d_{sr}	18.146								
Source to Receiver	d	33.693								
Parallel component distance	a	33								
Path Difference (ISO 9613-2)	$\delta (z)$	10.872								

Frequency	(Hz)	63	125	250	500	1000	2000	4000	8000	Barrier Atten
Wavelength	λ (m)	5.444	2.744	1.372	0.686	0.343	0.172	0.086	0.043	
Fresnel Nr	N	3.994	7.924	15.848	31.696	63.391	126.414	252.828	505.656	
Attenuation	dB	19.18	22.08	25.05	28.04	31.04	34.03	37.04	40.05	33

9.2 Distance Attenuation Calculation

Calculated using the following formula, based on the inverse square law:

$$L_p (R2) = L_p (R1) - 20\log(R2/R1)$$

Where:

$L_p (R1)$ = Known sound pressure level at first location (measured value)

$L_p (R2)$ = Second position (unknown sound pressure level)

$R1$ = Distance from noise source to position of known sound pressure level ($L_p(R1)$)

$R2$ = Distance from noise source to second position ($L_p(R2)$)

9.3 MP1 (ASHP) Time History

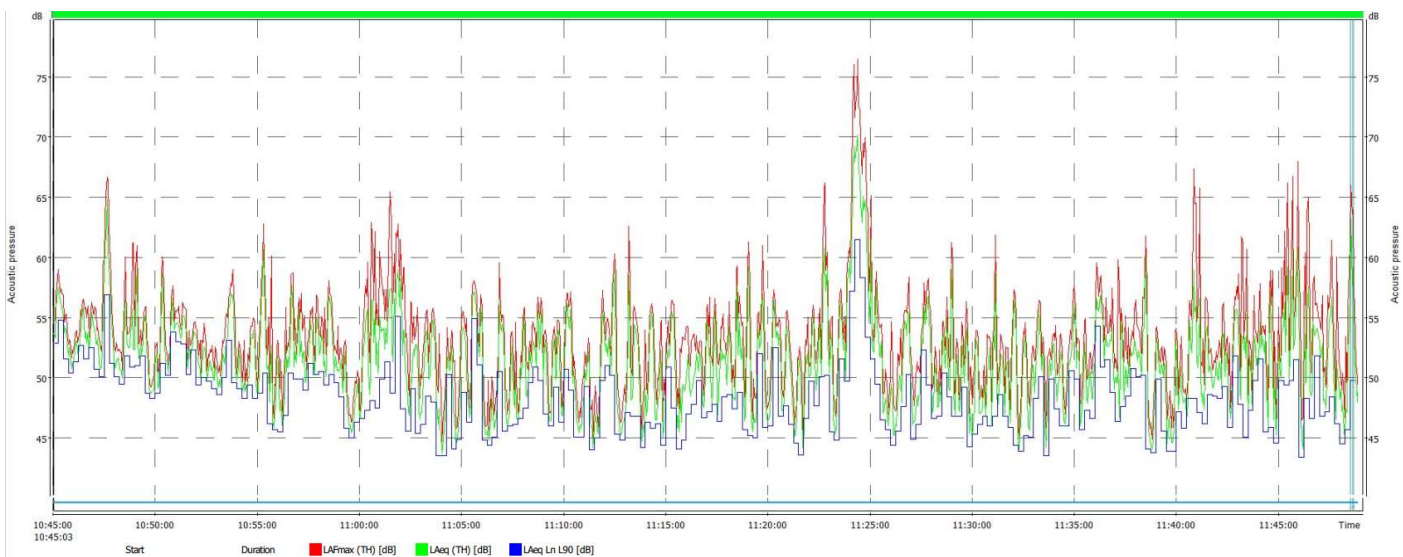


Chart 1: MP1 Time History

9.4 MP2 Time History

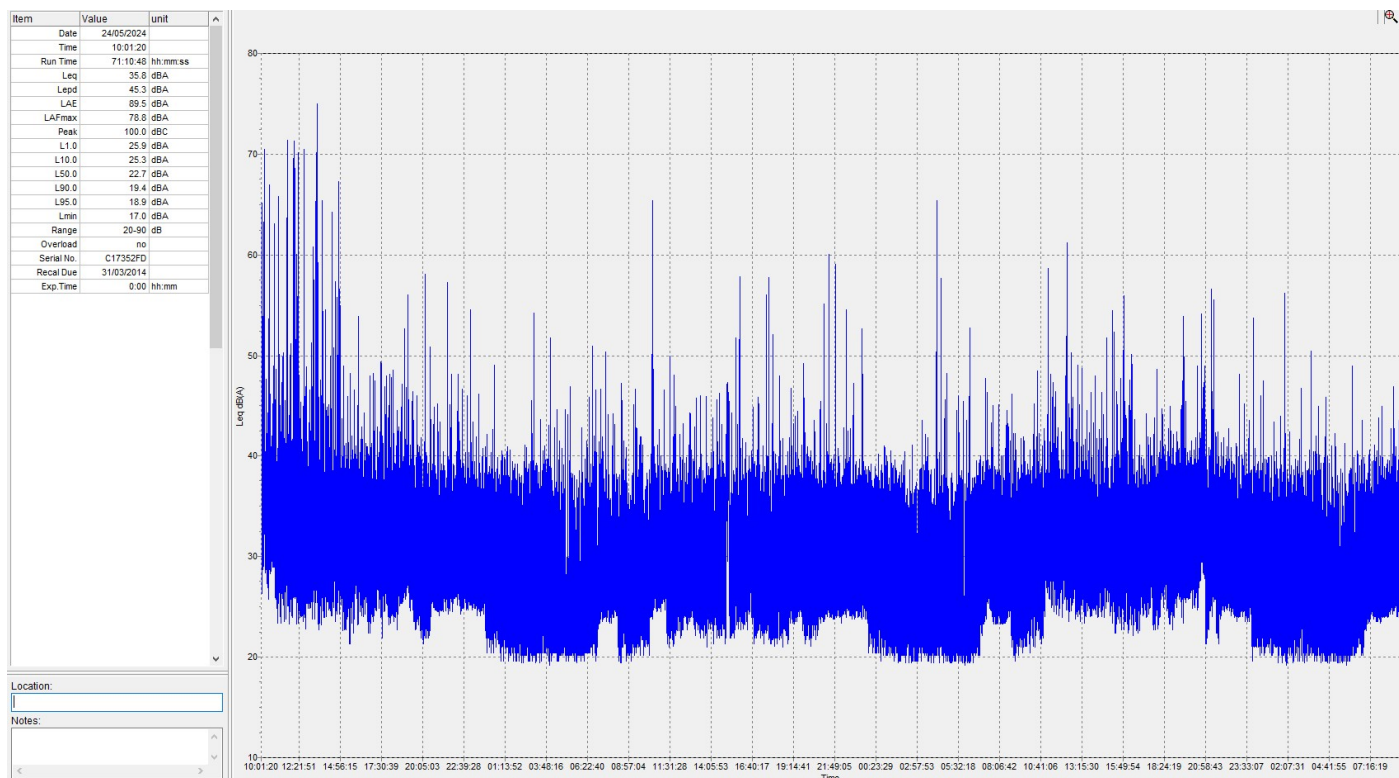


Chart 2: MP2 Time History

9.5 MP3 Time History

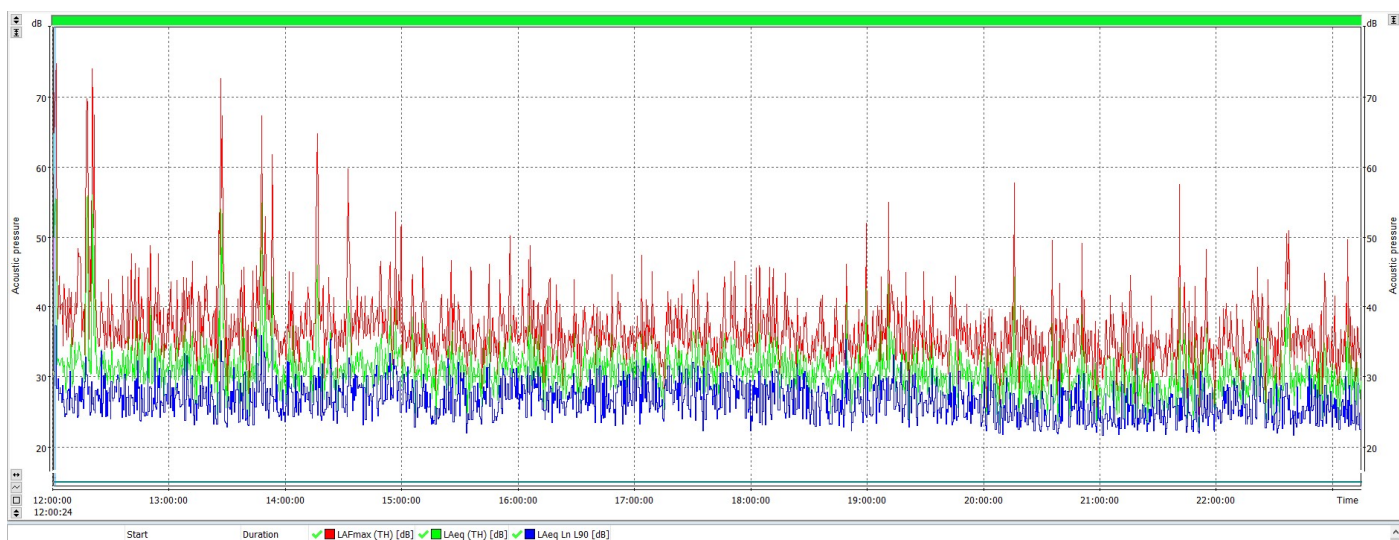


Chart 3: MP3 Time History (24.05.24 Day)

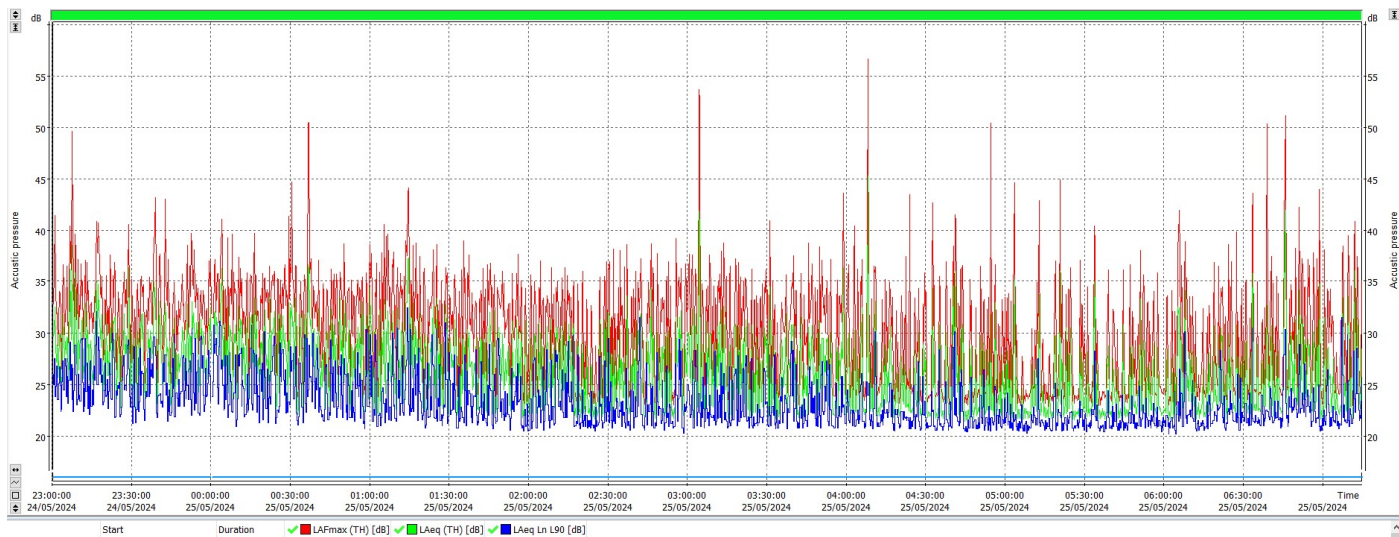


Chart 4:MP3 Time History (24.05.24 Night)

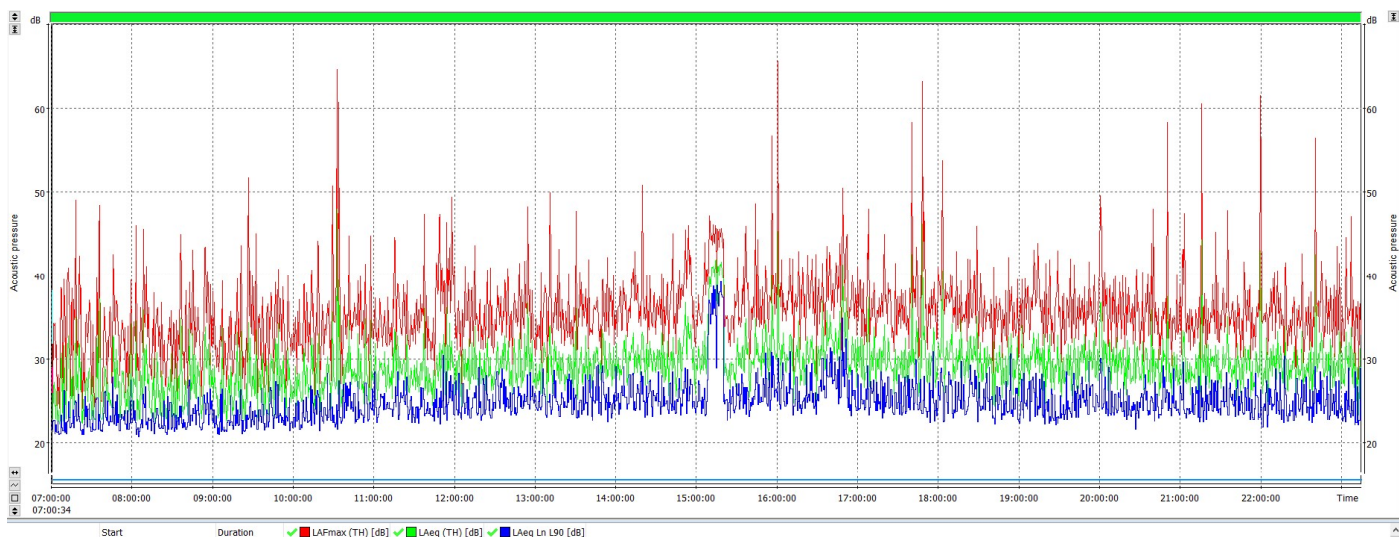


Chart 5:MP3 Time History (25.05.24 Day)

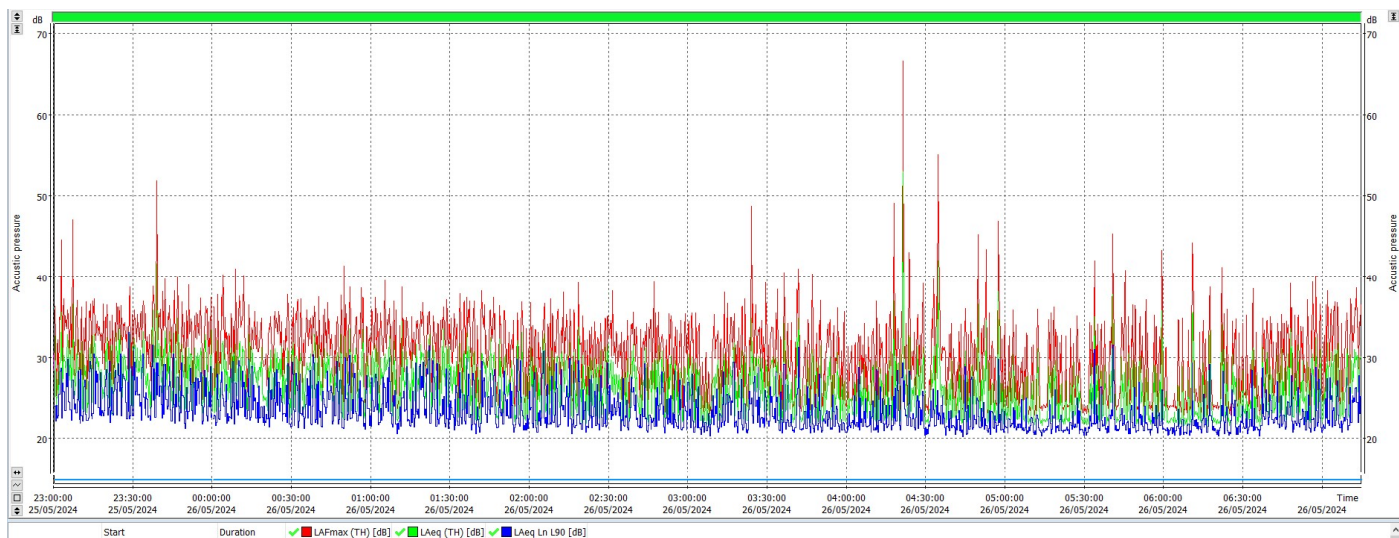


Chart 6:MP3 Time History (25.05.24 Night)

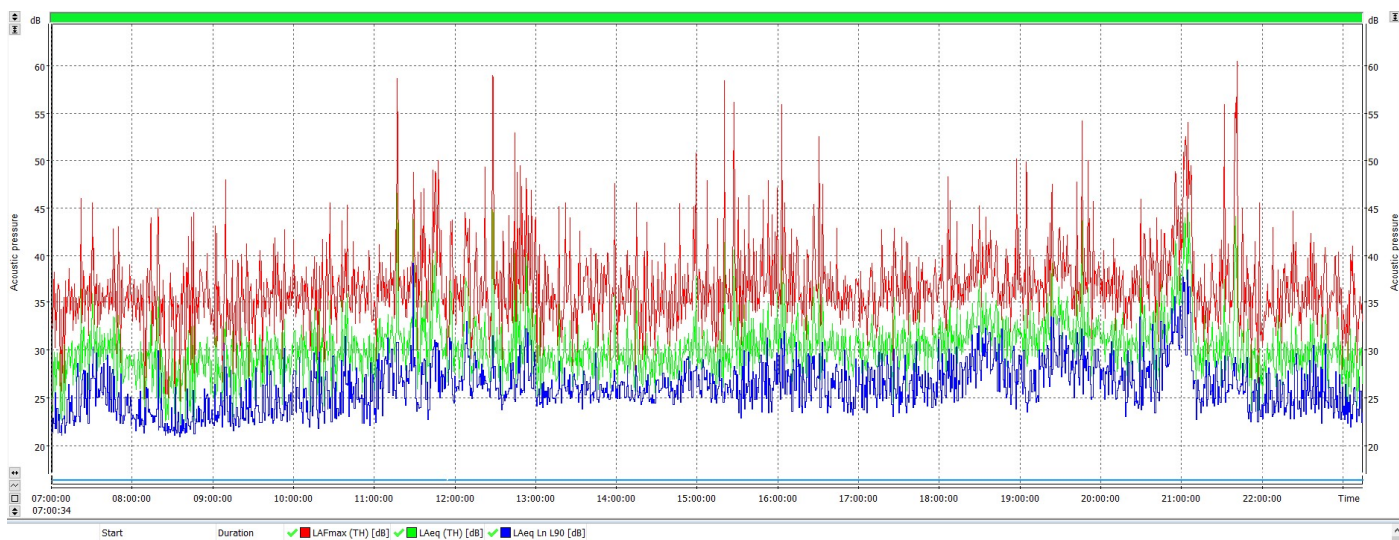


Chart 7:MP3 Time History (26.05.24 Day)

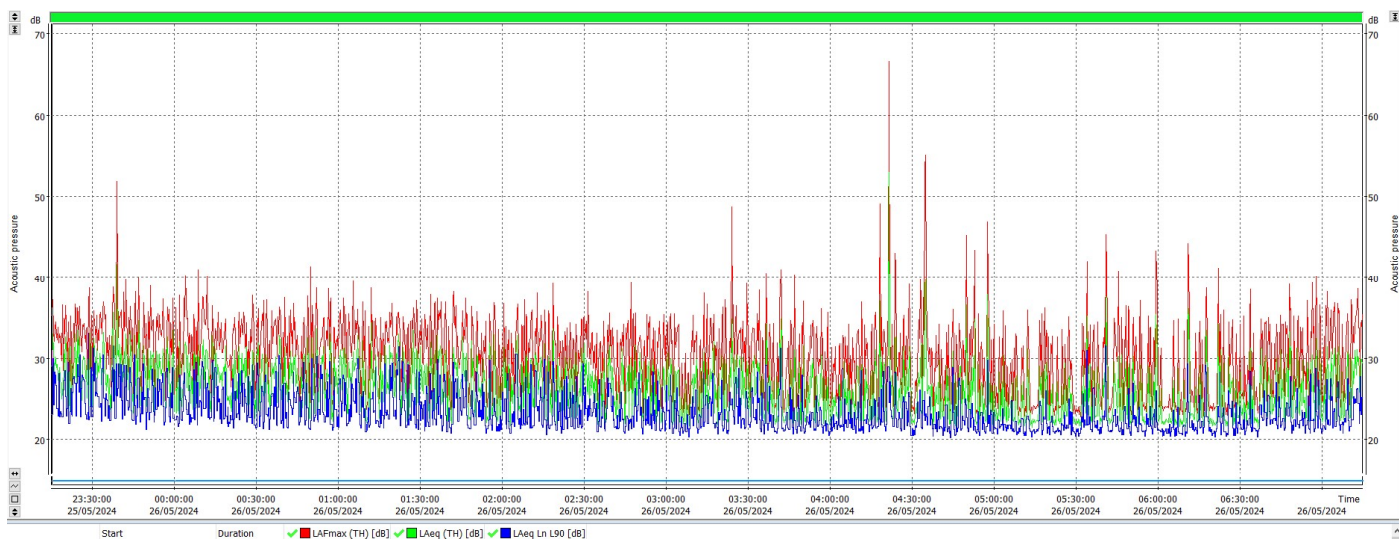


Chart 8:MP3 Time History (26.05.24 Night)

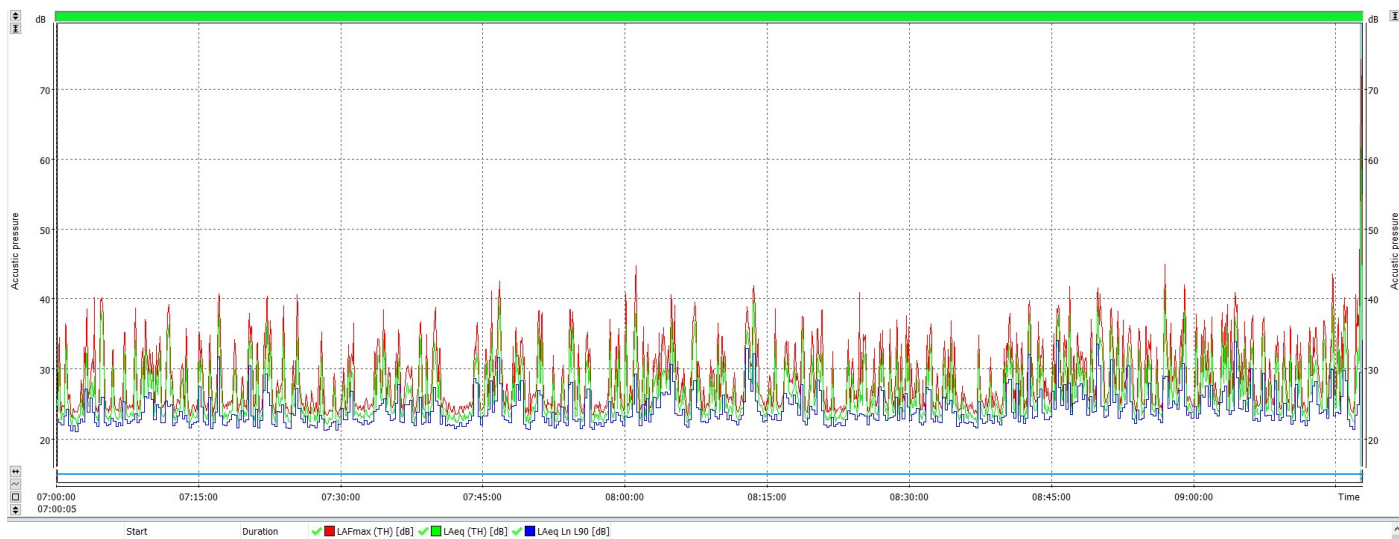


Chart 9:MP3 Time History (27.05.24 Day)