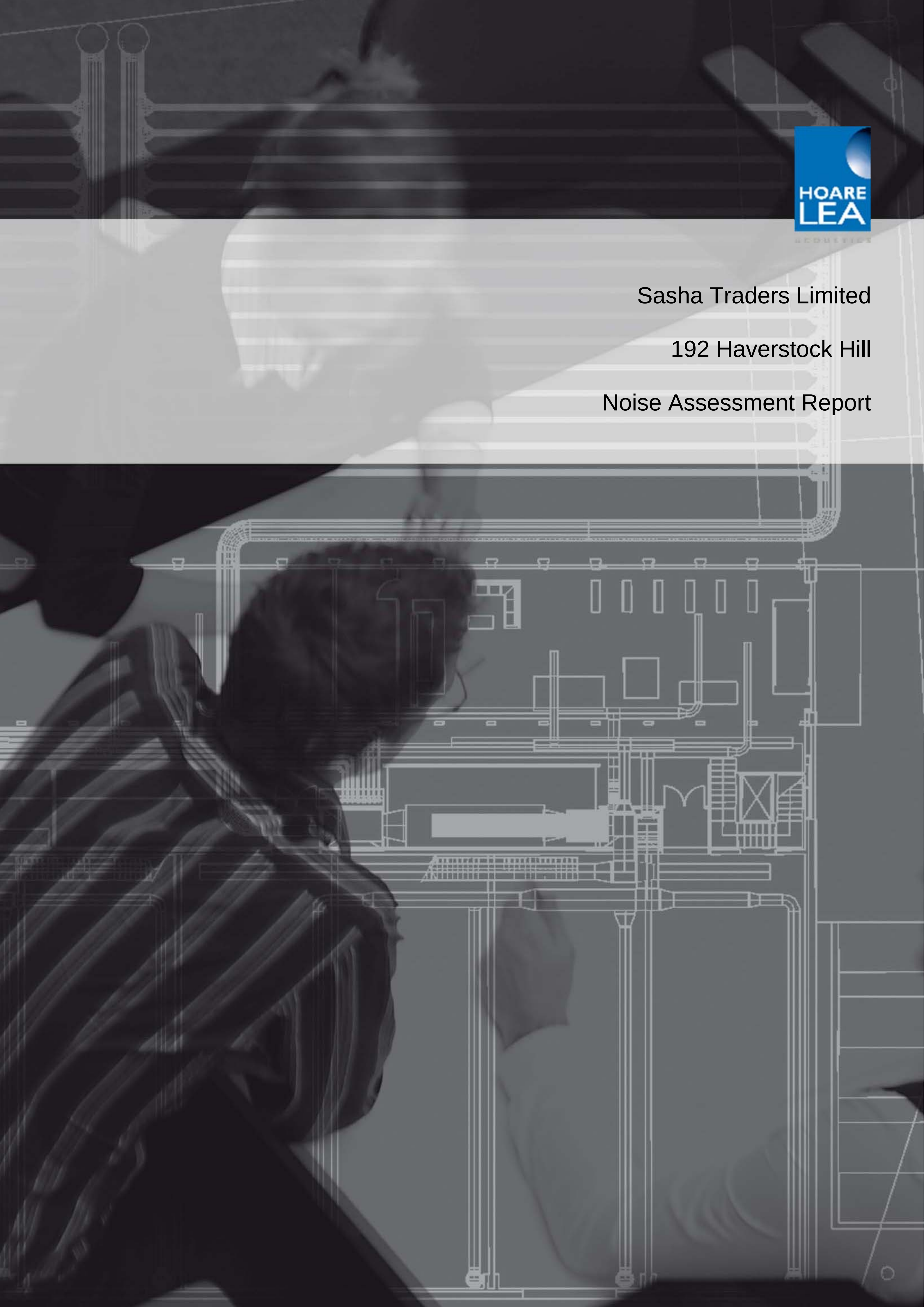

Sasha Traders Limited

192 Haverstock Hill

Noise Assessment Report

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Audit Sheet

Revision	Description	Date	Issued by	Reviewed by
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1	For Issue	16/02/2016	SG	JNB
2	With additional survey	11/03/2016	SG	JNB
3	Preliminary Plant Noise Assessment	28/11/2016	SG	JNB
4	Minor amendments	21/12/2016	SG	JNB

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1.0 Introduction

Hoare Lea Acoustics have been appointed by Sasha Traders Limited to prepare a noise assessment for the proposed development at 192 Haverstock Hill. The proposed development comprises a six storey development with retail use on the basement and ground floors and residential dwellings above.

A plant installation is proposed to be installed at roof level in a screened compound.

A background noise survey has been conducted during daytime and night time periods to characterise the prevailing noise climate.

An assessment of plant noise emissions has been made on the basis of local and national planning guidance.

2.0 Policy

2.1 National Planning Policy

2.1.1 National Planning Policy Framework

The NPPF sets out the Government's planning policies for England and how these are expected to be applied.

Section 11 paragraph 123 of NPPF states:

'Planning policies and decisions should aim to:

- Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- Mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;
- Recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put upon them because of changes in nearby land uses since they were established;
- Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason;'

Reference is made to the DEFRA Noise Policy Statement for England 2010 (NPSE). This latter document is intended to apply to all forms of noise other than that which occurs in the workplace and includes environmental noise and neighbourhood noise in all forms.

NPSE advises that the impact of noise should be assessed on the basis of adverse and significant adverse effect but does not provide any specific guidance on assessment methods or limit sound levels. Moreover, the document advises that it is not possible to have 'a single objective noise-based measure…that is applicable to all sources of noise in all situations'. It further advises that the sound level at which an adverse effect occurs is 'likely to be different for different noise sources, for different receptors and at different times'.

2.1.2 Noise Policy Statement for England

Noise Policy Statement for England 2010 advises that noise impact should be assessed on the basis of adverse and significant adverse effect but does not provide any specific guidance on assessment methods or noise limits.

NPSE introduces the following concepts of noise effects which it states have been applied by the World Health Organisation:

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.

Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.

No guidance is defined in relation to these effects in terms of limiting values of noise within the NPSE. The World Health Organisation guidelines (WHO Night Noise Guidelines 2009) adopt these definitions but NPSE does not apply the noise values contained in the guidelines.

The document advises that it is not possible to have 'a single objective noise based measure…. that is applicable to all sources of noise in all situations.' (paragraph 2.15) It further advises that the sound level at which an adverse effect occurs is likely to be different for different noise sources, for different receptors at different times (paragraph 2.22).

2.1.3 Planning Practice Guidance 2014

The Planning Practice Guidance (PPG) has been published online to provide greater details in relation to the relevance of noise to planning following the introduction of the NPPF and NPSE.

It states under the heading *'How to Determine the Noise Impact'* that the following should be considered by local authorities:

- *'whether or not a significant adverse effect is occurring or likely to occur;*
- *whether or not an adverse effect is occurring or likely to occur; and*
- *whether or not a good standard of amenity can be achieved.'*

The overall effect of both construction and when a development is complete should be considered.

In line with NPSE this includes identifying where noise exposure is above or below the significant observed adverse effect level and the lowest observed adverse effect level for a given situation. The observed effects are defined in the table below which is detailed in the section headed *'How to Recognise when Noise could be a concern?'*

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable 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	
Noticeable 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; closing windows for some of the time because of the noise. Potential for non-awakening 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	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. having to keep windows closed most of the time, avoiding certain activities during periods of intrusion. 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
Noticeable 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

Table 1: PPG Noise Exposure Hierarchy

It is important to note that no specific noise parameters are defined in the text or target noise levels provided.

Under the heading *'What factors influence whether noise could be a Concern?'* the subjective nature of noise is discussed. It is stated that there is no simple relationship between noise levels and the impact on those affected. This depends on how various factors combine in particular situations, these include:

- *'The source and absolute level of the noise together with the time of day it occurs. Some types and level 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 contained 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 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. In both cases a suitable alternative means of ventilation can be found in the Building Regulations;*
- *In cases where existing noise sensitive locations already experience high noise levels, a development that is expected to cause even a small increase in noise may result in a significant adverse effect occurring even though little to no change in behaviour would be likely to occur.*
- *If external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended.'*

2.2 Local Planning Policy

2.2.1 The London Plan

The Spatial Development Strategy for Greater London (The London Plan), 2011

Policy 5.3 of the London Plan, 'Sustainable Design and Construction' states that:

"*The highest standards of sustainable design and construction should be achieved in London […] Major development proposals should meet the minimum standards outlined in the Mayor's supplementary planning guidance and this should be clearly demonstrated within a design and access statements. The standards include measures to: […] minimise pollution (including noise).*"

Policy 7.15 (4A.20) 'Reducing Noise and Enhancing Soundscapes' states that: "*Development proposals should seek to reduce noise by*:

- *minimising the existing and potential adverse impacts of noise on, from, within, or in the vicinity of, development proposals*
- *separating new noise sensitive development from major noise sources wherever practicable through the use of distance, screening, or internal layout in preference to sole reliance on sound insulation*
- *promoting new technologies and improved practices to reduce noise at source."*

Amendment paragraph 7.52 supporting Policy 7.15 REDUCING NOISE AND ENHANCING SOUNDSCAPES (October 2013)

7.52 Reducing noise pollution and protecting good soundscape quality where it exists, contributes to improving quality of life. The Mayor's published Ambient Noise Strategy[35] contains policies and proposals on noise related to road and rail traffic, aircraft, water transport and industry. The GLA Act 1999 excludes some sources from the definition of 'ambient noise', such as construction and neighbour noise, where powers are held by borough councils. London Plan policies address the spatial implications of the Ambient Noise Strategy. These policies may require further alteration depending on the spatial implications of the Noise Policy Statement for England.

2.2.2 Camden Local Plan

The London Borough of Camden Local Plan Document was adopted in 2015 and sets out the strategic and development management policies for the Borough. This contains one policy relating to noise and sets noise limits for new development.

Policy A4 Noise and Vibration

Policy A4 includes general guidance on noise and vibration within the Borough.

The Council will seek to ensure that noise and vibration is controlled and managed. We will not grant planning permission for:
a. development likely to generate unacceptable noise and vibration impacts;
or
b. development sensitive to noise in locations with existing high levels of noise unless appropriate attenuation measures are provided.

Development that exceeds Camden's Noise and Vibration Thresholds (Appendix 2) will not normally be permitted.

We will only grant permission for noise generating development, including plant and machinery, if it can be operated without causing harm to amenity and does not exceed our noise thresholds. We will also seek to minimise the impact on local amenity from deliveries and the demolition and construction phases of development.

Conditions and planning obligations may be used where development is likely to cause harm or is in close proximity to noise sensitive uses.

In addition, the supporting text states that emergency equipment which are only to be used for short periods must be no more than 10 dB above the background level ($L_{A90,15min}$).

Appendix 2 Noise Thresholds

Appendix 2 gives more detailed noise and vibration limits for different uses and adjacencies.

Noise description and location of measurement	Period	Time	Sites adjoining railways	Sites adjoining roads
Noise at 1 metre external to a sensitive façade	Day	0700-1900	74 dB $L_{Aeq,12h}$	72 dB $L_{Aeq,12h}$
Noise at 1 metre external to a sensitive façade	Evening	1900-2300	74 dB $L_{Aeq,4h}$	72 dB $L_{Aeq,4h}$
Noise at 1 metre external to a sensitive façade	Night	2300-0700	66 dB $L_{Aeq,8h}$	66 dB $L_{Aeq,8h}$

Table A: Noise levels on residential sites adjoining railways and roads at which planning permission will not normally be granted.

Noise description and location of measurement	Period	Time	Sites adjoining railways	Sites adjoining roads
Noise at 1 metre external to a sensitive façade	Day	0700-1900	65 dB $L_{Aeq,12h}$	62 dB $L_{Aeq,12h}$
Noise at 1 metre external to a sensitive façade	Evening	1900-2300	60 dB $L_{Aeq,4h}$	57 dB $L_{Aeq,4h}$
Noise at 1 metre external to a sensitive façade	Night	2300-0700	55 dB $L_{Aeq,8h}$	52 dB $L_{Aeq,8h}$
Individual noise events several times an hour	Night	2300-0700	>82 dB L_{ASmax}	>82 dB L_{ASmax}

Table B: Noise levels on residential sites adjoining railways and roads at and above which attenuation measures will normally be required.

Vibration description and location of measurement	Period	Time	Vibration levels
Vibration inside critical areas such as hospital operating theatre	Day, Evening and Night	0000-2400	0.1 VDV $ms^{-1.75}$
Vibration inside dwellings	Day and Evening	0700-2300	0.2 to 0.4 VDV $ms^{-1.75}$
Vibration inside dwellings	Night	2300-0700	0.13 VDV $ms^{-1.75}$
Vibration inside offices	Day, Evening and Night	0000-2400	0.4 VDV $ms^{-1.75}$
Vibration inside workshops	Day, Evening and Night	0000-2400	0.8 VDV $ms^{-1.75}$

Table C: Vibration levels from uses such as railways, roads, leisure and entertainment premises and/or plant or machinery at which planning permission will not normally be granted.

Noise description and location of measurement	Period	Time	Noise level
Noise at the nearest noise sensitive receptor	Day, Evening and Night	0000-2400	10 dB(A) < $L_{A90,15min}$
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at the nearest noise sensitive receptor	Day, Evening and Night	0000-2400	15 dB(A) < $L_{A90,15min}$
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at the nearest sensitive receptor	Day, Evening and Night	0000-2400	15 dB(A) < $L_{A90,15min}$
Noise at the nearest noise sensitive receptor L_{A90} > 60 dB	Day, Evening and Night	0000-2400	55 dB $L_{Aeq,15min}$
NB: Noise should be measured 1m external to a noise sensitive façade in the case of buildings and noise at the nearest edge of the noise sensitive space in the case of gardens, balconies or open spaces.			

Table D: Noise levels from plant and machinery at which planning permission will not be granted.

2.3 BS 4142: 2014

British Standard 4142: 2014 Method for rating and assessing industrial and commercial sound (BS 4142:2014) provides an objective method for rating the significance of impact from industrial and commercial operations. It describes a means of determining noise levels from fixed plant installations and determining the background noise levels that prevail on a site.

The assessment of the impacts is based on the subtraction of the measured background noise level ($L_{A90,T}$) from the rating level ($L_{Ar,Tr}$). The rating level is the specific source noise level in question (either measured or predicted) with graduated corrections (from +0 dB to +9 dB) for tonality, impulsivity, intermittency and other sound characteristics which may be determined either subjectively or objectively, if necessary. The difference is then compared to the following criteria to evaluate the likelihood of complaint.

- a difference of around +10 dB is likely to be an indication of a significant adverse impact, depending on context;
- a difference of around +5 dB is likely to be an indication of an adverse impact, depending on context; and
- a difference of +0 dB or less is an indication of the specific sound source having a low impact, depending on the context.

3.0 Site description

3.1 Existing Site

The existing site consists of an empty plot of land in the Belsize Park area within the London Borough of Camden. It is located on Haverstock Hill, beside the Belsize Park underground station.

The proposed development is adjacent to a small car park to the rear, and retail premises with dwellings above to the north, which are the closest noise sensitive receptors.

The proposed development site (indicative only) is identified in Figure 1 below. It should be noted that the properties highlighted in orange within Figure 1 are the nearest residential properties and represent the closest noise sensitive receptors.

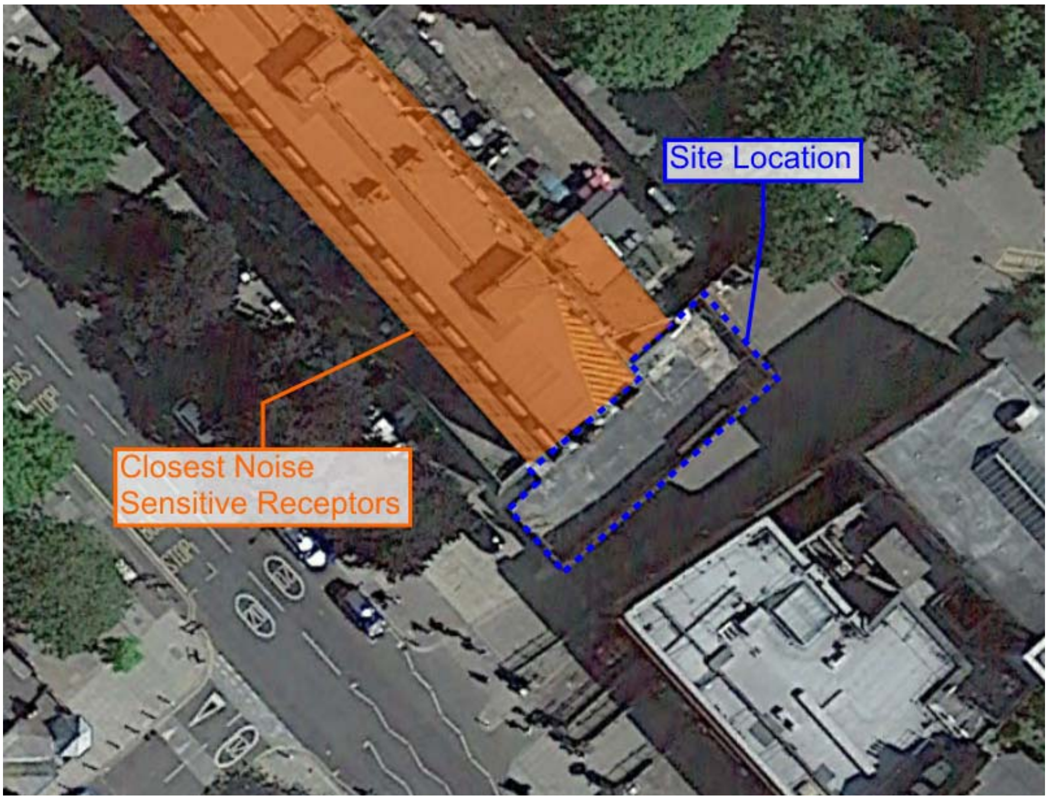


Figure 1: Site Location (Indicative Only)

3.2 Local Noise Environment

The noise climate is that of a typical inner city area. This is predominantly formed of both nearby and distant road traffic noise. Other audible sound sources are the tennis courts to the north east, and plant noise from the rear of the underground station.

Unattended noise surveys were undertaken at positions representative of the nearest residential properties to the proposed plant locations at the front and rear of the site in order to capture the typical background noise levels in these areas.

Attended surveys were also carried out at both the front and rear of the site to determine the main noise sources present at the site.

4.0 Environmental Noise Survey

An unattended acoustic survey has been carried out at the proposed site to establish the prevailing environmental noise conditions local to the site, so as to determine building services plant noise emission limits.

An attended survey has been undertaken in order to establish the noise level across the site.

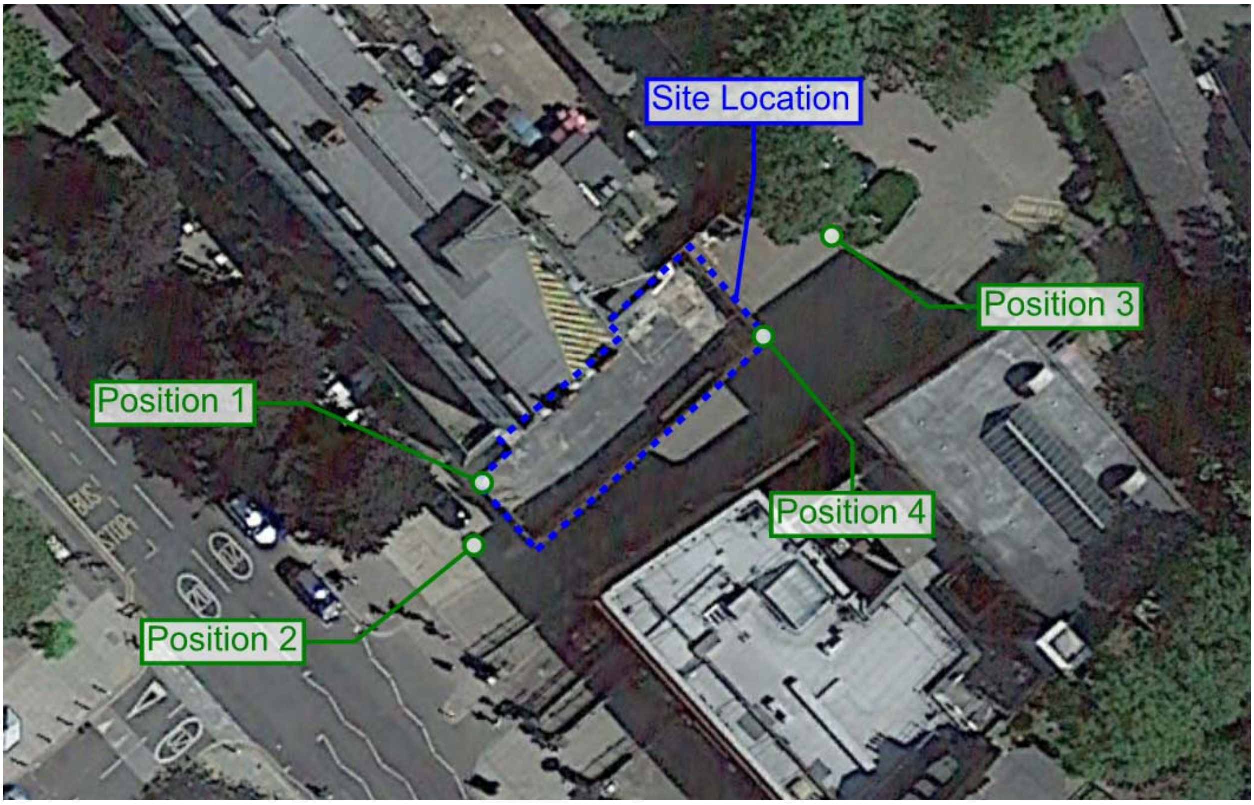


Figure 2: Measurement Locations (Indicative Only)

4.1 Unattended Survey Methodology

The survey comprised of two unattended measurements. The first of these was carried out over four days by a logging sound level meter at a raised location at the front façade. The second was carried out over a six day period at a raised location at the rear façade.

The position of the noise monitoring is representative of the front and rear façades of the proposed development. The measurements were considered free-field measurements as they were taken more than 3.5 metres from any significant acoustically reflecting surface other than the ground, and were at a height of approximately 3 metres above ground floor level. These are shown as Positions 1 and 4 in Figure 2.

The unattended measurements consisted of 15-minute samples of ambient noise levels ($L_{Aeq,15min}$ in dB), maximum noise levels ($L_{Amax,15min}$ in dB), and background noise levels ($L_{A90,15min}$ in dB). The front survey was over a 4 day period from Tuesday 19th January 2016 to Friday 22nd January 2016, and the rear over a 6 day period from Thursday 25th February 2016 to Tuesday 1st March 2016. These measurements give a representative view of a typical day.

The measurement instrumentation used is listed in Appendix A attached and a general acoustic terminology is provided in Appendix B.

During the first measurement period, the wind speed exceeded 5 m/s during some periods, and precipitation occurred during the final day of the survey period, so these have not been included in this assessment. Temperatures remained mild throughout the survey period. During the second survey, conditions remained suitable throughout.

The equipment was calibrated before and after each measurement period, and no significant drift was detected.

4.2 Attended Survey Methodology

An attended daytime survey was carried out on Wednesday 13th January 2016. This was to establish the noise level at the front and rear of the proposed development and establish the main noise sources present.

Two attended positions were used, and all measurements consisted of 5-minute samples of ambient noise levels ($L_{Aeq,5min}$ in dB), maximum noise levels ($L_{Amax,5min}$ in dB), and background noise levels ($L_{A90,5min}$ in dB) in third-octave band resolution.

The measurements were considered free-field measurements as they were taken more than 3.5 metres from any significant acoustically reflecting surface other than the ground, and were at a height of approximately 1.3 metres above ground floor level. These are shown as Positions 2 and 3 in Figure 2.

During the measurement period, conditions were dry and mild throughout, and the wind speed remained below 5 m/s.

The measurement instrumentation used is listed in Appendix A attached. The equipment was calibrated before and after the measurement period, and no significant drift was detected.

4.3 Results Summary

The results of the unattended survey at Position 1 have been presented in Table 2 and 3 below.

Date	$L_{Aeq,16h}$, dB	Minimum $L_{A90,15min}$, dB
Tuesday 19th January 2016	64	50
Wednesday 20th January 2016	63	50
Thursday 21st January 2016	63	55
Overall	**63**	**50**

Table 2: Summary of daytime unattended noise survey at Position 1.

Date	$L_{Aeq,8h}$, dB	Minimum $L_{A90,15min}$, dB
Tuesday 19th January 2016	58	44
Wednesday 20th January 2016	58	45
Overall	**58**	**44**

Table 3: Summary of night-time unattended noise survey at Position 1.

The background noise levels measured at the front façade indicate that the lowest levels could drop to approximately L_{A90} 50 dB during the daytime, and L_{A90} 44 dB during the night-time.

The results of the unattended survey at Position 4 have been presented in Tables 4 and 5 below.

Date	$L_{Aeq,16h}$, dB	Minimum $L_{A90,15min}$, dB
Thursday 25th February 2016	56	48
Friday 26th February 2016	57	48
Saturday 27th February 2016	59	47
Sunday 28th February 2016	59	46
Monday 29th February 2016	57	47
Tuesday 1st March 2016	59	51
Overall	**58**	**47**

Table 4: Summary of daytime unattended noise survey at Position 4.

Date	$L_{Aeq,8h}$, dB	Minimum $L_{A90,15min}$, dB
Thursday 25th February 2016	52	44
Friday 26th February 2016	52	45
Saturday 27th February 2016	53	46
Sunday 28th February 2016	52	45
Monday 29th February 2016	52	43
Overall	**52**	**44**

Table 5: Summary of night-time unattended noise survey at Position 4.

The background noise levels measured at the rear façade indicate that the lowest levels could drop to approximately L_{A90} 47 dB during the daytime, and L_{A90} 44 dB during the night-time.

These results show that the difference between the front and rear façades is approximately 3 dB during the daytime, and 0 dB during the night-time.

The results of the attended survey are presented below:

Date	Time Period	L_{Aeq}, dB	Typical $L_{A90,5min}$, dB
Position 2	30 minutes	62	55
Position 3	25 minutes	53	49

Table 6: Summary of attended noise survey.

The attended survey is comparable to the unattended survey on the loudest day, showing that the unattended results are a good representation of the prevailing noise climate.

5.0 Noise Sensitive Areas

A noise sensitive area is defined as a landscape or building where the occupiers are likely to be sensitive to noise created by new plant installed in the proposed development, including residential areas. The nearest noise sensitive location is therefore identified as the existing neighbouring residential dwelling as indicated in Figure 1.

6.0 Plant Noise Limits

The noise levels have been assessed for plant at both the front and rear of the development. Both are approximately 5 metres from the closest noise sensitive receptors. The measurements taken at Positions 1 and 4, as shown in Figure 2, are considered representative of the closest noise sensitive receptors to these two plant locations.

The typical lowest background noise level at the position representative of the closest receptor window at the front façade is 50 dB(A) during the day, and 44 dB(A) at night. At the position representative of the closest receptor window at the rear façade, this is 47 dB(A) during the day, and 44 dB(A) at night

The Camden Local Plan gives noise limits for plant and machinery as 10 dB below the background noise level at the closest noise sensitive receptor, assuming no tonality or impulsivity. The distance used is representative of the central rear and central front locations. It is assumed that this applies to non-scheme receptors.
The plant noise results are summarised in Table 7 below:

Plant Location	Distance, m	Time	Background Level, dB L_{A90}	Limit Criteria, dB $L_{Ar,Tr}$
Front	5	Day	50	40
	5	Night	44	34
Rear	5	Day	47	37
	5	Night	44	34

Table 7: Summary of plant noise limits at the closest noise sensitive receptor.

If tonality or impulsivity are present, a 5 dB penalty must be applied to these values in line with Local Authority guidance.

7.0 Plant Noise Assessment

A preliminary assessment of plant noise emissions from the proposed development has been undertaken, the installation comprises roof mounted heat pump units. These are located behind a screen to provide acoustic barrier effects to neighbouring properties. The potential manufacturer's data is shown below, this is the sound power level of the heat pump unit. There are nine units in the enclosure, the enclosure is around 1.4 metres taller than the acoustic centre of the source.

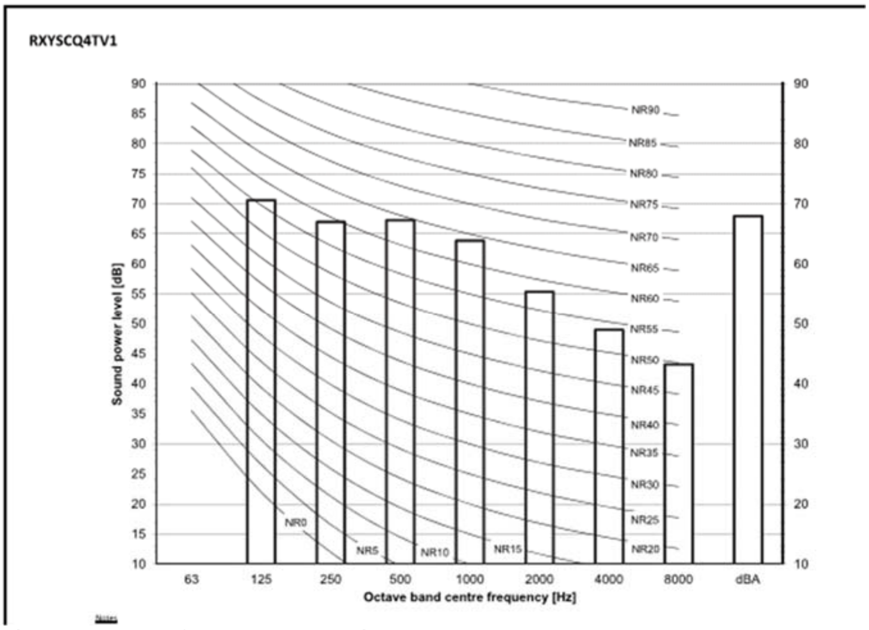


Figure 3: Manufacturers Sound Power Data

The above sound power data has been used to calculate the resultant sound pressure level at the closest affected receptors using the methodology of ISO 9613-2: Acoustics-Attenuation of outdoor sound during propagation outdoors.

The total sound pressure level at the closest affected property with all units at maximum capacity has been calculated to be 34 dB $L_{Aeq,T}$. Examining the data above there does not appear to be any tonal content so that this is taken to be the rating level of the noise. It is likely that all units will be at maximum capacity at any time. This is compliant with the proposed limits.

8.0 Summary

National and Local Planning Policy have been reviewed in relation to plant noise emissions. A noise survey has been conducted to characterise the noise climate at a position representative of the closest noise sensitive receptors.

Measured noise data has been used to determine the resultant noise limits at the closest noise sensitive receptors. Noise limits have been determined that follow the guidance given by the London Borough of Camden Council.
A preliminary assessment of the plant noise data shows that the Local Authority requirements for plant noise emissions can be met with the potential installation.

APPENDICES

Appendix A: Noise Monitoring Equipment

Sound Level Meter & Sound Calibrator – Unattended Survey

Rion Type NL-31 Sound Level Meter (Serial Number 00431027)
Rion Type NH-21 Pre-Amplifier (Serial Number 07194)
Rion Type UC-53A Microphone (Serial Number 320327)
Rion Type NC-74 Sound Calibrator (Serial Number 34304644)

Sound Level Meter & Sound Calibrator – Attended Survey

Brüel & Kjær Type 2250 Sound Level Meter (Serial Number 3003702)
Brüel & Kjær 2C0032 Pre-amplifier (Serial Number 19784)
Brüel & Kjær 4189 Microphone (serial Number 2887161)
Brüel & Kjær Type 4231 Sound Calibrator (Serial Number 2147258)

Appendix B: Acoustic Terminology

Decibel (dB)
The decibel is the unit used to quantify sound pressure levels. The human ear has an approximately logarithmic response to acoustic pressure over a very large dynamic range (typically 20 micro-Pascals to 100 Pascals). Therefore, a logarithmic scale is used to describe sound pressure levels and also sound intensity and power levels. The logarithms are taken to base 10. Hence an increase of 10 dB in sound pressure level is equivalent to an increase by a factor of 10 in the sound pressure level (measured in Pascals). Subjectively, this increase would correspond to a doubling of the perceived loudness of sound.

The Sound Pressure
The Sound Pressure is the force (N) of sound on a surface area (m^2) perpendicular to the direction of the sound. The SI-units for the Sound Pressure are Nm^{-2} or Pa (Pascal).

Sound is measured with microphones responding proportionally to the sound pressure - *p*. The power is proportional to the square of the sound pressure.

The Sound Pressure Level
The lowest sound pressure possible to hear is approximately 2×10^{-5} Pa (2 ten billionths of an atmosphere) .
It therefore convenient to express the sound pressure as a logarithmic decibel scale related to this lowest human audible sound

$$L_p = 10\log(p^2/p_{ref}^2) = 10\log(p/p_{ref})^2 = 20\log(p/p_{ref})$$

where;
L_p = *sound pressure level (dB)*
p = *sound pressure (Pa)*
$p_{ref} = 2 \times 10^{-5}$ - *reference sound pressure (Pa)*

Doubling the sound pressure level is an increase of 6 dB.

Sound Pressure Level of some Common Sources

Source	**Sound Pressure Level** *dB*
Threshold of hearing	0
Rustling leaves	20
Quiet whisper	30
Home	40
Quiet street	50
Conversation	60
Inside a car	70
Loud singing	80
Motorcycle (10 m)	90
Lawn mower (1m)	100
Diesel truck (1m)	110
Amplified music (1m)	120
Jet plane (1m)	130

Frequency
The frequency - cycles per second - of a sound is expressed in hertz - Hz.

Wavelength
The wavelength of sound is the distance between analogous points of two successive waves.

Octave and Third Octave Bands
An octave is the interval between two points where the frequency at the second point is twice the frequency of the first.

The human ear is sensitive to sound over a range of frequencies between approximately 20 Hz to 20 kHz and is generally more sensitive to medium and high frequencies than to low frequencies within the range. There are many methods of describing the frequency content of a noise. The most common methods split the frequency range into defined bands, in which the mid-frequency is used as the band descriptor and in the case of octave bands is double that of the band lower. For example two adjacent octave bands are 250 Hz and 500 Hz. Third octave bands provide a fine resolution by dividing each octave band into three bands. For example third octave bands would be 160 Hz, 250 Hz, 315 Hz for the same 250 Hz octave band.

A musical octave is eight full tones, and 12 semi tones above or below another tone, with twice or half as many vibrations per second as the other tone. Where a semi tone is $2^{\wedge(1/12)}$ times the frequency of the semi tone below.

A-Weighting
The 'A' weighting is a correction term applied to the frequency range in order to mimic the sensitivity of the human ear to noise. It is generally used to obtain an overall noise level from octave or third octave band frequencies. An 'A' weighted value would be written as dB(A), or including A in the parameter term.

$L_{eq,T}$
The $L_{eq,T}$ is a parameter defined as the equivalent continuous sound pressure level. Over a defined time period 'T', it is the sound pressure level equivalent to the acoustic energy of the fluctuating sound signal. The $L_{eq,T}$ can be seen to be an "average" sound pressure level over a given time period (although it is not an arithmetic average). Typically the $L_{eq,T}$ will be an 'A' weighted noise level in dB(A). It is commonly used to describe all types of environmental noise sources.

$L_{10,T}$
The $L_{10,T}$ is a parameter defined as the sound pressure level exceeded for 10% of the measurement period 'T'. It is a statistical parameter and cannot be directly combined to other acoustic parameters. It is generally used to describe road traffic noise.

$L_{90,T}$
The $L_{90,T}$ is a parameter defined as the sound pressure level exceeded for 90% of the measurement period 'T'. It is a statistical parameter and cannot be directly combined to other acoustic parameters. It is generally used to describe the prevailing background noise level or underlying noise level.

$L_{max,\ T}$
The $L_{max,\ T}$ is maximum noise level measured during the specified period 'T'.

Free Field
A measurement taken in the free field is at least 3.5m from reflecting vertical surfaces and 1.2m from the ground.

Façade
A measurement is influenced by the reflection of sound from the façade of a building within 3.5m. A façade measurement is made 1m in front of the vertical building surface.

Fast /Slow Time Weighting
Sound level meters can take averages using fast or slow response times.

D_{nT}
The difference in sound level between a pair of rooms, in a stated frequency band, corrected for the reverberation time. See BS EN ISO 140-4:1998.

$D_{nT,w}$
A single-number quantity which characterizes the airborne sound insulation between rooms. See BS EN ISO 717-1:1997

$D_{nT,w}$ + C_{tr}
A single-number quantity which characterizes the airborne sound insulation between rooms using noise spectrum no. 2 as defined in BS EN ISO 717-1:1997. See BS EN ISO 717-1:199

C_{tr}
The correction to a sound insulation quantity (such as $D_{nT,w}$) to take account of a specific sound spectra

R_w
A single-number quantity which characterizes the airborne sound insulation of a material or building element in the laboratory. See BS EN ISO 717-1:1997.

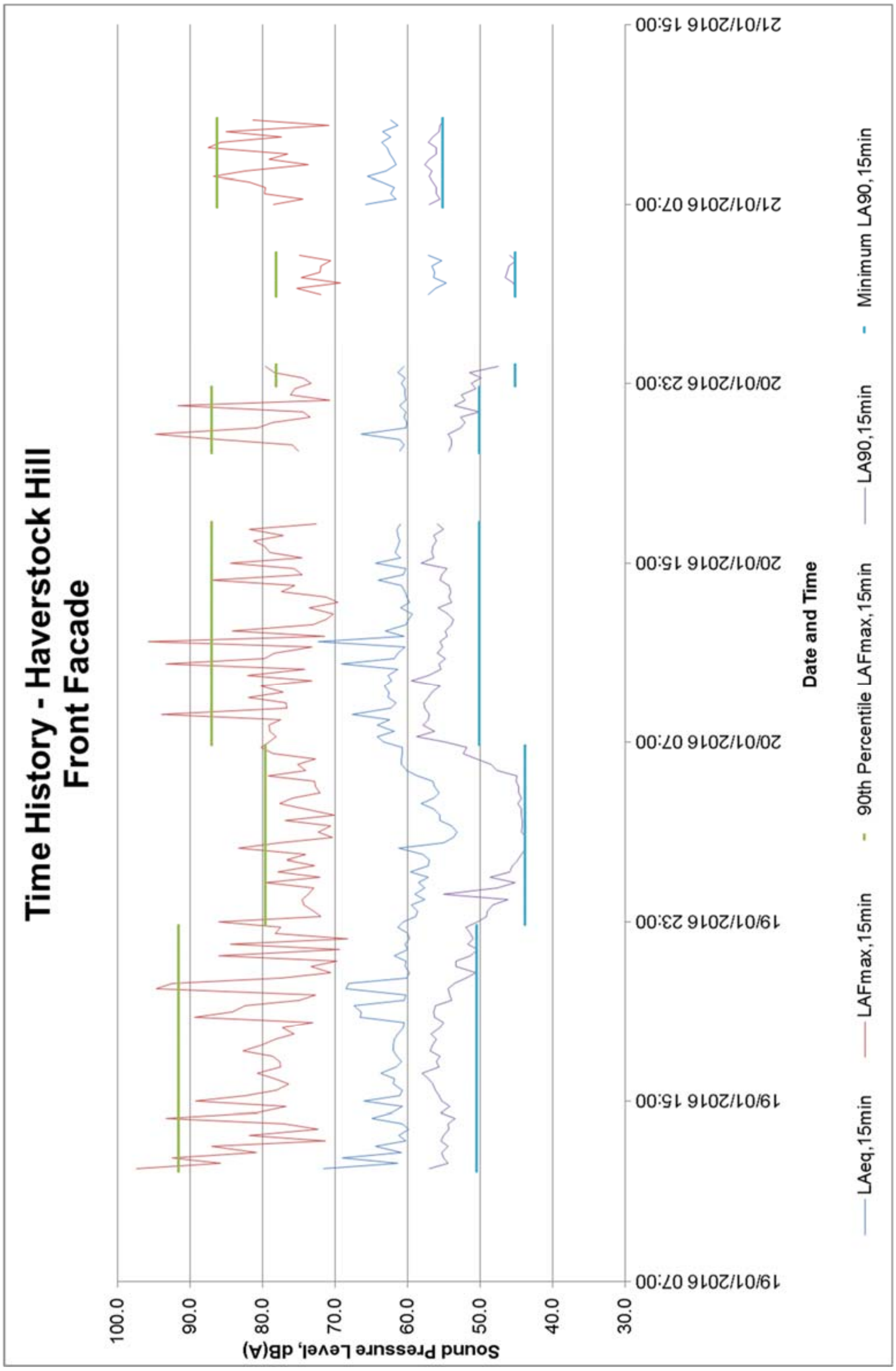
Sound reduction index (R_i)
A quantity, measured in a laboratory, which characterizes the sound insulating properties of a material or building element in a stated frequency band. See BS EN ISO 140-3:1995.

Specific Noise Level, $L_{Aeq,Tr}$
This is the equivalent continuous A-weighted sound pressure level at the assessment position due to a specific noise source operating over a given time interval.

Rating Level, $L_{Ar,Tr}$
This is the equivalent continuous A-weighted sound pressure level at the assessment position due to a specific noise source operating over a given time interval that includes adjustments to account for characteristic features of the noise source.

Appendix C: Unattended Noise Logger Time History Graph

Figure C1: Position 1 - Time History Graph



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Noise Assessment Report

Figure C2: Position 4 - Time History Graph