Fulwood Place Limited

Elizabeth House, Fulwood Place, London

Noise Impact Assessment

MLM. Group

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Document History

Client: Fulwood Place Limited
Project: Elizabeth House, Fulwood Place, London
Document Title: Noise Impact Assessment
Document Reference: 102034-MLM-ZZ-XX-RP-U-0001
MLM Reference: 102034/001R/OS

Revision	Status	Description	Author	Checked/Approved	Date
00	I	For Information	Ondrej Suska	Mark Scaife	6/12/2017

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1 Introduction

MLM Consulting Engineers Ltd has been commissioned by Fulwood Place Limited to assess the impact of noise at the proposed development of Elizabeth House, 4-7 Fulwood Place, London, in respect of the site's suitability for office use.

The proposed development comprises an internal refurbishment of the existing building as well as a new build extension on the proposed fourth and fifth floors. At 4-7 Fulwood Place, the redevelopment is to provide an office building on basement, ground and five upper floors, and other associated works.

The suitability of the site for development of the proposed office usage has been based on the current development proposals and the measured noise levels. Where predicted levels indicate that noise may be a determining factor in the granting of planning permission, mitigation measures have been considered to ensure satisfactory conditions are met.

The report firstly defines appropriate acoustic design standards. It goes on to set out the measured acoustic data and presents the assessment of potential noise impacts in relation to the development. Whilst every effort has been made to ensure that this report is easily understood, it is technical in nature; a glossary of terms in Appendix A is included to assist the reader.

2 Policy and Assessment Methodology

2.1 Local Authority Requirements

Following consultation with Environmental Health Officer Peter Rodham of the London Borough of Camden, the requirements of the Local Planning Authority are as follows:

"External noise from machinery, extract/ ventilation ducting, mechanical gates, etc.

Condition: Prior to [commencement] [use] of the development, details shall be submitted to and approved in writing by the Council, of the external noise level emitted from plant/ machinery/ equipment and mitigation measures as appropriate. The measures shall ensure that the external noise level emitted from plant, machinery/ equipment will be lower than the lowest existing background noise level by at least 10dBA, by 15dBA where the source is tonal, as assessed according to BS4142:2014 at the nearest and/or most affected noise sensitive premises, with all machinery operating together at maximum capacity. A post installation noise assessment shall be carried out where required to confirm compliance with the noise criteria and additional steps to mitigate noise shall be taken, as necessary. Approved details shall be implemented prior to occupation of the development and thereafter be permanently retained.

Reason: To ensure that the amenity of occupiers of the development site/ surrounding premises is not adversely affected by noise from plant/mechanical installations/ equipment.

Anti- vibration mounts and silencing of machinery, etc.

Condition: Prior to commencement of the development, details of anti-vibration measures shall be submitted to and approved in writing by the Council. The measures shall ensure that [machinery, plant/ equipment] [extract/ ventilation system and ducting] are mounted with proprietary anti-vibration isolators and fan motors are vibration isolated from the casing and adequately silenced. Approved details shall be implemented prior to occupation of the development and thereafter be permanently retained.

Reason: To ensure that the amenity of occupiers of the development site/ surrounding premises is not adversely affected by vibration."

In addition to the above, requirements on construction work noise will also apply. Further on, it has been agreed that this assessment will be undertaken in line with BS8233:2014 as well as BREEAM and BS4142:2014.

2.2 National Planning Policy Framework

National Planning Policy Framework (NPPF)[1] published on 27 March 2012 sets out the Government's economic, environmental and social planning policies for England. It summarises in a single document all previous national planning policy advice. Taken together, these policies articulate the Government's vision of sustainable development, which should be interpreted and applied locally to meet local aspirations.

The NPPF sets out the Government's requirements for the planning system only to the extent that it is relevant, proportionate and necessary to do so. It provides a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities. Under Section 11; Conserving and enhancing the natural environment, the following is stated:

1 Department for Communities and Local Government, March 2012. National Planning Policy Framework. HMSO.

The planning system should contribute to and enhance the natural and local environment by:

- *Preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability.*

The document goes on to state:

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 on them because of changes in nearby land uses since they were established; and*
- *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.*

As stated above, this document makes reference to avoiding noise generation from new developments that would adversely impact on health and quality of life.

2.3 Planning Practice Guidance – Noise

The National Planning Practice Guidance (NPPG[2]) has been revised and updated to be easily accessible and available online. The Noise Guidance advises on how planning can manage potential noise impacts in new development. It sets out when noise is relevant to planning and outlines the following Observed Effect Levels to determine the noise impact:

- *Significant observed adverse effect level: This is the level of noise exposure above which significant adverse effects on health and quality of life occur;*
- *Lowest observed adverse effect level: this is the level of noise exposure above which adverse effects on health and quality of life can be detected;*
- *No observed effect level: this is the level of noise exposure below which no effect at all on health or quality of life can be detected.*

The document recognises the subjective relationship between noise levels and the impact on those affected, and advises on factors which may influence on whether noise could be a concern.

2.4 National Planning Practice Guidance, England

Further guidance in relation to the National Planning Policy Framework and the Noise Policy Statement for England has been published in the National Planning Practice Guidance in England: Noise (NPPG)[3], which summarises the noise exposure hierarchy, based on the likely average response. This is reproduced in Table 1 below.

[2] National Planning Practice Guidance, Department for Communities and Local Government (DCLG), March 2014
[3] Department for Communities and Local Government (DCLG), 2014. National Planning Practice Guidance for England: Noise. DCLG.

Table 1: Significance Criteria From NPPG In England: Noise			
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; 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			
Noticeable 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
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

2.5 British Standard 8233:2014

BS8233 provides guidance on appropriate internal ambient noise levels in various types of room/building, including offices. The table below shows these guidance levels.

Table 2: BS8233:2014 Internal Ambient Noise Level Guidance	
Room Type	Design Range L_{Aeq}
Open Plan Office	45 – 50
Staff/Meeting Room, training Room	35 – 45
Executive Office	35 – 40

Generally, only the maximum desirable noise level needs to be targeted, however in some cases such as open-plan offices, the lower limit would provide a moderate noise level to provide masking in shared spaces without causing disturbance.

Whilst not a planning issue, BS8233 also provides guidance on providing noise control within offices which should be noted at an early stage. The guidance is as follows:

In open-plan offices, the maximum reduction that can be expected between screened workstations separated by 2.5 m to 3.0 m is 15 dB to 25 dB, but the cumulative noise of equipment and people might provide a masking background level which makes this adequate for general needs. The screening should be absorbent-faced and at least 1.5 m high. Low ceilings and absorbent ceilings can assist in reducing sound transmission between workstations. Where ceilings are higher than 3 m, it is more difficult to provide acceptable acoustic conditions in open-plan offices with absorption coverage lower than Class A. Where exposed soffits are used additional absorption might be required. Carpet having good sound-absorbent properties is a desirable floor finish. It should be noted that if the width of the room is small, reflections from the side walls might reduce the effectiveness of the arrangement.

2.6 British Council for Offices (BCO) – Guide to Specification 2014

The BCO provide guidelines for external noise intrusion which are generally based on the BS8233 noise criteria. The guidance states that the internal ambient noise level criteria should be met over the duration of the normal working day, typically between 09:00 and 17:00. The BCO noise criteria are outlined below.

Table 3: BCO Internal Ambient Noise Level Guidance	
Room Type	Design Range L_{Aeq}
Open Plan Office	NR40
Staff/Meeting Room, training Room	NR38
Executive Office	NR35

Note: NR (Noise Rating) levels are approximately equal to the measured sound pressure level dBA minus 6dB.

Building services noise to internal areas should also be designed to achieve the levels set out in table 3.

In addition to the average noise level criteria, it is recommended that the $L_{Amax(fast)}$ noise intrusion levels should not normally be more than 55dB in open-plan/speculative offices or 50dB in cellular offices.

2.7 British Standard 4142:2014 Method for Rating and Assessing Industrial and Commercial Sound

BS4142 describes the method for assessing whether noise sources of an industrial, commercial or fixed nature are likely to give rise to complaints from people residing in the area.

New commercial development can often incorporate plant and processes that have the potential to generate noise, especially if operated at night-time when background noise levels are at their lowest.

BS 4142 sets out a method to assess whether noise from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises are likely to give rise to complaints from noise-sensitive receptors in the vicinity.

The procedure contained in BS 4142 for assessing the likelihood of complaint is to compare the measured or predicted noise level from the source in question, the LAeq,T 'specific noise level', immediately outside the dwelling with the LA90,T background noise level.

Where the noise contains a tonality, impulsivity, intermittency and other sound characteristics, then a correction depending on the grade of the aforementioned characteristics of the sound is added to the specific noise level to obtain the LAr,Tr 'rating noise level'. A correction to include the consideration of a level of uncertainty in noise measurements, data and calculations can also be applied when necessary.

BS 4142 states: "*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*". An estimation of the impact of the specific noise can be obtained by the difference of the rating noise level and the background noise level and considering the following:

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

A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.

A difference of around +5dB 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.

The periods associated with day and night, for the purposes of the Standard, are considered to be 07.00 to 23.00 and 23.00 to 07.00, respectively.

2.8 BREEAM New Construction 2014 - Offices

The guidance contained in this report is based on the BREEAM New Construction SD5076: 5.0 - 2014 issued by the BRE. This standard states acoustics criteria for office buildings within two items: HEA 05 Acoustic Performance and POL 05 Reduction of Noise Pollution.

The purpose of BREEAM HEA 05 'Acoustic Performance' assessment is to ensure the buildings' acoustic performance, including sound insulation, meet the appropriate standards for its purpose. For office buildings there are three credits available:

- **Sound Insulation**: The sound insulation between acoustically sensitive rooms and other occupied areas complies with the performance criteria given in Section 7 of BS 8233:2014.
- **Internal indoor ambient noise levels**: Achieve indoor ambient noise levels that comply with the design ranges given in Section 7 of BS 8233:2014.

- **Reverberation**: Achieve the requirements relating to sound absorption and reverberation times, where applicable, set out in Section 7 of BS 8233:2014.

At this stage of the design, only internal indoor ambient noise levels are to be considered, reverberation and Sound Insulation criteria are to be addressed within future design stages.

2.8.1 BREEAM Pol 05

The requirements of BREEAM Credit Pol 05 are reproduced below.

i. The credit can be awarded by default where there are or will be no noise sensitive areas or buildings within 800m radius of the assessed development.
ii. Where there are or will be noise-sensitive areas or buildings within 800m radius of the assessed development a noise impact assessment in compliance with BS 7445:1991 has been carried out and the following noise levels measured/determined.

   a) Existing background noise levels at the nearest or most exposed noise sensitive development to the proposed development or at a location where background conditions can be argued to be similar.

   b) The rating noise level resulting from the new noise-source (see also Compliance note: Compliance at the design stage).

iii. The noise impact assessment must be carried out by a suitably qualified acoustic consultant holding a recognised acoustic qualification and membership of an appropriate professional body (see relevant definitions in the Additional Information section).
iv. The noise level from the proposed site/building, as measured in the locality of the nearest or most exposed noise-sensitive development, is a difference no greater than +5dB during the day (0700hrs to 2300hrs) and +3dB at night (2300hrs to 0700hrs) compared to the back-ground noise level.
v. Where the noise source(s) from the proposed site/building is greater than the levels described in Criterion 4, measures have been installed to attenuate the noise at its source to a level where it will comply with Criterion 4.

Given the presence of noise-sensitive residential and commercial properties within 800m of Plots 0200 and 0710, a noise impact assessment is required in order to satisfy the requirements of this credit.

It is assumed that Criterion 2 of the above requirements should reference a noise impact assessment in compliance with BS 4142:2014, with any noise monitoring undertaken being in compliance with BS 7445:2003, as the latter standard does not provide a means of undertaking a noise impact assessment and the terminology in the specification is consistent with BS 4142:2014.

2.9 BS5228:2009 – Code Of Practice for Noise and Vibration Control on Construction and Open Sites

2.9.1 Part 1 - Construction Noise

Noise levels generated by construction activities have the potential to impact upon nearby noise-sensitive receptors; however, the magnitude of the potential impact will depend upon a number of variables. In the UK, BS5228 presents the appropriate methodology to predict and assess noise emission levels from a construction site.

BS5228 sets out a methodology for predicting, assessing and controlling noise levels arising from a wide variety of construction and related activities. As such, it can be used to predict noise levels arising from the operations at proposed construction sites. BS5228 also sets out tables of sound power levels generated by a wide variety of construction plant to facilitate such predictions.

Noise levels generated by the proposed site operations and experienced at local receptors will depend upon a number of variables, the most important of which are the:

- Amount of noise generated by plant and equipment being used at the site, generally expressed as a sound power level;
- Periods of operation of the plant at the site, known as the 'on-time';
- Distance between the noise source and the receptor, known as the 'stand-off';
- Attenuation due to ground absorption or barrier screening effects; and
- Reflection of noise due to the presence of hard vertical faces such as walls.

BS5228 gives several examples of acceptable limits for construction or demolition noise. The most simplistic is based upon the exceedance of fixed noise limits and paragraph E.2 states that: "Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut."

Paragraph E.2 goes on to state: "Noise levels, between say 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the Site boundary should not exceed: 70 decibels (dBA) in rural, suburban areas away from main road traffic and industrial noise or 75 decibels (dBA) in urban areas near main roads in heavy industrial areas. These limits are for daytime working outside living rooms and offices."

This assessment considers the criteria set out in Section E.3 of BS5228, which considers impact significance based upon the change in ambient noise associated with construction activities. It is stated that this can be considered as "an alternative and/or additional method to determine the significance of construction noise levels". Example Method 1 (The ABC Method) considers the existing ambient noise environment (the L_{Aeq} noise level environment) at the neighbouring sensitive receptors and proposes levels which are not to be exceeded.

Table E.1 of BS5228 sets out significance effect threshold values at receptors. The process for determining this requires the determination of the ambient noise level at the relevant receptor (rounded to the nearest 5dB), which is then compared to the total noise level, including the predicted construction noise level. If the combined noise level exceeds the appropriate category value, then the impact is deemed to be significant. The relevant statistics from Table E.1 are set out in Table 4 below. Compliance with these guidance levels should ensure a minor impact.

Table 4: Construction Noise Impact Significance Criteria

Assessment category and threshold value period	Threshold value, in decibels - dB(A)		
	Category A	Category B	Category C
Daytime	65	70	75
Evenings and weekends	55	60	65
Night-time	45	50	55
NOTE 1 A significant effect has been deemed to occur if the total L_{Aeq} noise level, including construction, exceeds the threshold level for the Category appropriate to the ambient noise level.			
NOTE 2 If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total L_{Aeq} noise level for the period increases by more than 3 dB due to construction activity.			

NOTE 3 Applied to residential receptors only.

A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.

C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

2.9.2 Part 2 - Construction Vibration

Vibration may be impulsive such as that due to hammer-driven piling; transient such as that due to vehicle movements along a railway; or continuous such as that due to vibratory driven piling.

The primary cause of community concern in relation to vibration generally relates to building damage from both construction and operational sources of vibration, although, the human body can perceive vibration at levels which are substantially lower than those required to cause building damage.

Damage to buildings associated solely with ground-borne vibration is not common and although vibration may be noticeable, there is little evidence to suggest that they produce cosmetic damage such as a cracks in plaster unless the magnitude of the vibration is excessively high. The most likely impact, where elevated levels of vibration do occur during the demolition and construction phases, is associated with perceptibility.

There are currently no British Standards that provide a methodology to predict levels of vibration from construction activities, other than that contained within BS5228: Part 2, which relates to vibratory piling and compaction.

Annex D of BS5228 Part 2 provides a number of measured vibration levels for piling. The data given in this annex is largely historical and comes from various forms of piling and kindred operations at various distances from the operation location.

Annex E, of the same document presents empirical formulae to predict levels of vibration from construction activities. These formulae enable a prediction of resultant peak particle velocities (PPV) for a variety of activities, scaling factors and parameters, and provide indicators of the probability of these figures to be exceeded.

To control the impact of vibration during site preparation and construction of a development, limits relating to the perceptibility of vibration are typically set.

BS5228 indicates that the threshold of human perception to vibration is around 0.15 mm/s, although it is generally accepted that for the majority of people vibration levels in excess of between 0.15 and 0.3 mm/s peak particle velocity (PPV) are just perceptible, which forms the basis of the recommend maximum permitted vibration levels of 1 mm/s PPV within occupied residential dwellings. Table 5 below summarizes vibrations significance criteria. The limits are presented in terms of PPV as it is the simplest indicator for both perceptibility and building damage.

Table 5: Demolition and Construction Vibration Significance Criteria	
Vibration Level, mm.s-1 PPV	Significance of Effect
>1.0	Major Adverse
0.30 - 1.0	Moderate Adverse
0.15 - 0.30	Minor Adverse
<0.15	Negligible
Notes The above vibration limits relate to maximum PPV ground borne vibration occurring in any one of three mutually perpendicular axes (one of which may be vertical). Vibration is to be measured on the foundation or on an external façade no more than 1m from the ground, or failing this, solid ground as near to the building façade as possible.	

3 Site

The site is located west of the pedestrian-only Fulwood Place, just north of the busy High Holborn in London borough of Camden. The immediate surrounding area of the site is mostly commercial, not untypical for the area. The existing building has been used as an office and has been recently decommissioned prior to the redevelopment.

The location of the proposed development site is identified in Figure 2.

Figure 2: Site Location

The nearest/worst-affected existing noise-sensitive receptors are the residential properties located at 7 Warwick Court at 11 meters away and 31-33 High Holborn at 30 meters away. The nearest commercial receptors are located near every boundary of the proposed development.

4 Noise Measurements

4.1 Survey Details

The prevailing noise conditions at the location of the proposed development have been determined by an environmental noise survey. The survey was undertaken over a typical weekday and weekend, between Wednesday 22 to Monday 27 November 2017. Two external long-term measurement positions and one external short spot measurement were used to gather representative noise levels affecting the site and the most affected residential as well as commercial receptors.

4.2 Noise Monitoring Methodology

All noise measurements were undertaken by a consultant certified as competent in environmental noise monitoring, and in accordance with the principles of BS 7445[4].

All acoustic measurement equipment used during the noise survey conformed to Type 1 specification of BS 61672[5]. A full inventory of this equipment is shown in table below.

Table 6: Inventory of Acoustic Measurement Equipment

Item	Make & Model	Serial Number
Sound Level Meter	01dB Duo	10965
Preamplifier	01dB PRE-23	10449
Microphone	GRAS 40CD	161799
Sound Level Meter	Rion NA-28	00860027
Preamplifier	Rion NH-23	60027
Microphone	Rion UC-59	10030
Sound Level Meter	01dB Solo	61280
Preamplifier	PRE-21S	14175
Microphone	GRAS 40AE	167948
Calibrator	Rion NC-74	34315165

The noise measurement equipment used during the surveys was calibrated at the start and end of the measurement period. The calibrator used had itself been calibrated by an accredited calibration laboratory within the twelve months preceding the measurements. No significant drift in calibration was found to have occurred on the sound level meter.

The microphone was fitted with a protective windshield, with an appropriate correction applied on the sound level meter.

[4] British Standard 7445: 2003: *Description and measurement of environmental noise*. BSI
[5] British Standard 61672: 2003: *Electroacoustics. Sound level meters*. Part 1 *Specifications.* BSI.

4.3 Weather Conditions

Weather conditions were dry with negligible wind during for the majority of the noise monitoring period.

4.4 Procedure and Measurement Positions

The Sound Level Meter (SLM) locations were acoustically within 3.5 meters of a reflective façade and relevant corrections have been applied. The microphones were fitted with a protective windshield, with an appropriate correction applied on the Sound Level Meter.

Measurements were carried out at 3 locations on the site, as described below and illustrated in Figure 3:

Microphone Position 1 – An unattended daytime and night-time measurement of sound along the eastern façade of the existing development. The microphone was attached onto a pole and extended at 1 meter from the rooftop above the existing third floor level facing Fulwood Place at 14m above the street level. This measurement deemed representative of the noise climate affecting the eastern façade of the development as well as the existing background noise levels in the area. Whilst the survey was largely unattended, during our time on site the sound environment was noted to have been affected by screened noise using High Holborn, pedestrian activity along Fulwood Place, noise emissions from numerous nearby plant items associated with the surrounding developments and occasional commercial aircrafts.

Microphone Position 2 – An unattended daytime and night-time measurement of sound along the western façade of the existing development. The microphone was attached onto a pole and extended at 1 meter from the rooftop above the existing third floor level facing the courtyard area of surrounding commercial buildings. Due to the presence of a roofed ground floor with plant items on top, the microphone was located only approximately 10 meters above the plant items, which would in this case be considered the local ground level. This measurement deemed representative of the noise climate affecting the western façade of the development as well as the existing background noise levels in the area. Whilst the survey was largely unattended, during our time on site the sound environment was noted to have been affected by noise emissions from a vast number of plant items associated with the surrounding commercial developments and some screened noise from the surrounding streets and occasional aircrafts.

Spot Measurement 1 – An attended 30 minute measurement of sound along the eastern façade of the existing development. The microphone was mounted onto a tripod and located at a height of 1.5 above the street level of Fulwood Place. This measurement deemed representative of the noise climate directly below Microphone Position 1 to obtain the change in noise climate throughout the 3 floors of the existing development. During our time on site the sound environment was noted to have been affected by noise using High Holborn, pedestrian activity along Fulwood Place and occasional commercial aircrafts. Plant noise emissions associated with the surrounding commercial developments have been noted to be inaudible at this location.

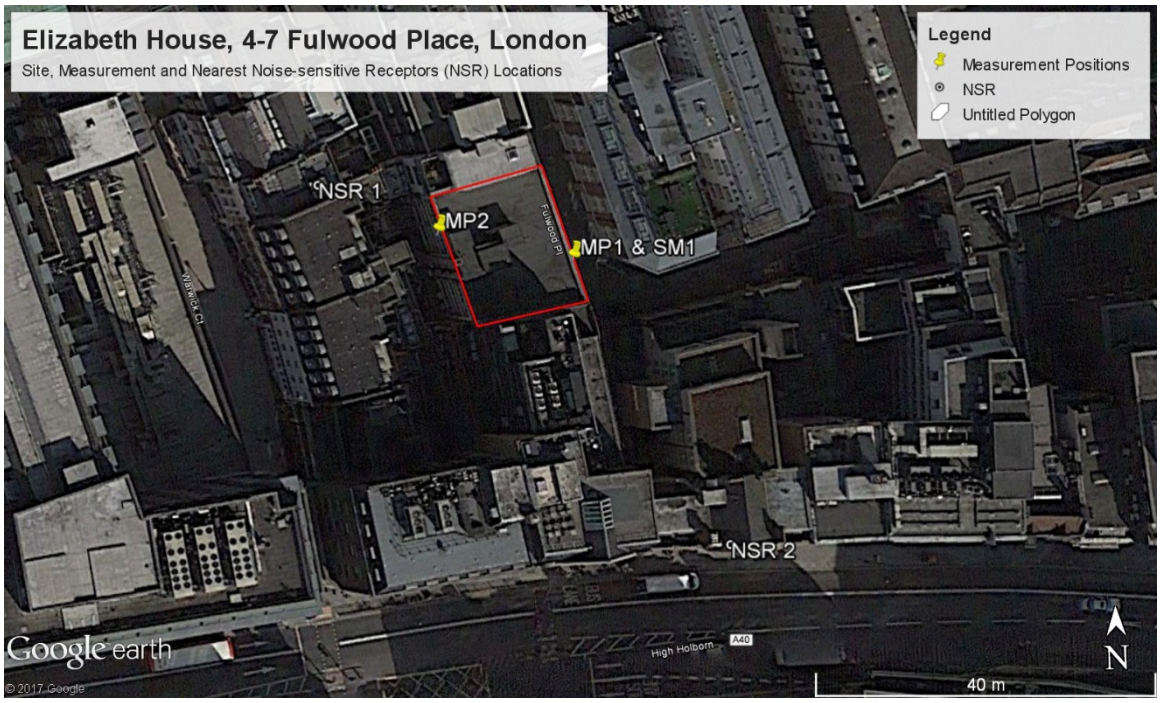


Figure 3: Site Location, Measurement Positions and the Nearest Noise-sensitive Receptor Location

4.5 Sound Measurement Results

The results of the sound monitoring, presented in terms of the measured daytime and night-time periods respectively, are summarised in Tables 7 and 8 below.

The short 30-minute Spot Measurement 1 measurement at street level of Fulwood Place is presented in comparison with the same period of the rooftop measurement at Measurement Position 1 in Table 9 to effectively assess the external noise level variation throughout the floors of the existing building.

Full-tabulated and charted results are presented in Appendix B of this report.

Table 7: Sound Measurement Results at Position 1

Day	Period	Sound Level, dB			
		$L_{Aeq,T}$	$L_{A90,T}$	$L_{A10,T}$	$L_{AFmax,T}$
Wednesday 22/11/17	Daytime (13:00 - 23:00)	52.7	49.0	53.7	73.7
	Office hours (13:00 – 17:00)	53.9	49.0	54.8	73.1
	Night-time (23:00 – 07:00)	50.2	47.0	51.6	74.8
Thursday 23/11/17	Daytime (07:00 – 23:00)	54.0	49.0	55.2	76.9
	Office hours (09:00 – 17:00)	53.6	50.0	54.4	76.8
	Night-time (23:00 – 07:00)	48.6	45.0	50.1	67.4
Friday 24/11/17	Daytime (07:00 – 16:00)	50.8	47.0	54.1	74.4
	Office hours (09:00 – 16:00)	53.7	48.0	54.5	74.3

	Night-time (23:00 – 07:00)	-	-	-	-

Table 8: Sound Measurement Results at Position 2					
Day	Period	Sound Level, dB			
		$L_{Aeq,T}$	$L_{A90,T}$	$L_{A10,T}$	$L_{AFmax,T}$
Wednesday 22/11/17	Daytime (13:15 - 23:00)	51.7	46.0	51.8	71.8
	Office hours (13:15 – 17:00)	53.3	52.0	53.9	70.7
	Night-time (23:00 – 07:00)	48.6	46.0	48.9	66.3
Thursday 23/11/17	Daytime (07:00 – 23:00)	52.3	52.0	52.5	71.4
	Office hours (09:00 – 17:00)	53.4	48.0	53.8	74.4
	Night-time (23:00 – 07:00)	47.3	44.0	47.9	58.9
Friday 24/11/17	Daytime (07:00 – 23:00)	52.6	52.0	52.6	68.8
	Office hours (09:00 – 17:00)	53.5	49.0	54.2	69.3
	Night-time (23:00 – 07:00)	45.9	43.0	46.4	59.9
Saturday 25/11/17	Daytime (07:00 – 23:00)	49.6	48.0	49.8	70.2
	Night-time (23:00 – 07:00)	44.8	43.0	45.6	60.4
Sunday 26/11/17	Daytime (07:00 – 23:00)	49.5	47.0	49.5	71.7
	Night-time (23:00 – 07:00)	47.0	44.0	47.4	58.9
Monday 27/11/17	Daytime (07:00 – 23:00)	53.6	53.0	53.5	75.3
	Office hours (09:00 – 17:00)	54.8	49.0	55.2	76.4
	Night-time (23:00 – 07:00)	47.2	44.0	47.5	57.5

Table 9: Simultaneous Sound Measurement Results at SM1 (street level) and MP1 (rooftop level)					
Position	Period	Sound Level, dB			
		$L_{Aeq,T}$	$L_{A90,T}$	$L_{A10,T}$	$L_{AFmax,T}$
Spot Measurement 1 (1.5m height)	Wednesday 22/11/17 (13:25 – 13:55)	55.6	51.2	57.6	73.9
Measurement Position 1 (13.7m height)	Wednesday 22/11/17 (13:25 – 13:55)	52.2	49.2	54.0	72.8

5 Noise Intrusion Assessment

It is clear from the results of the noise monitoring exercise that the area of the upper floors of the proposed office development is exposed to environmental noise levels with the highest ambient noise levels in the order of 54 dB $L_{Aeq,16hr}$ daytime, 55 dB $L_{Aeq,16hr}$ office hours and 50 dB $L_{Aeq,8hr}$ night-time. The external noise levels have been found to be nearly identical at either of the two assessed façades.

The results presented in Table 9 have identified that the variation in external noise levels throughout 4 floors is 3.4 dB L_{Aeq}, which results in an attenuation of approximately 0.85 dB L_{Aeq} with each increasing floor.

5.1 Internal Noise Level and Façade Requirements

The key significance criteria adopted for this assessment are those contained within BS8233:2014 and BCO guidance as summarised earlier in this report.

In order to achieve the target internal noise levels, it is necessary to determine the minimum acoustic performance requirements of the ventilation system and the building envelope.

5.1.1 Office Envelope Sound Reduction Requirements

Table 10 sets out the broadband sound reduction requirements for the office facades of the proposed development, in order to achieve the target criteria.

Table 10: Minimum Façade Broadband Sound Reduction Requirements dB

Location	Floor	Period	Measured External Noise Level, dB	Target Internal Noise Level, dB	Required Broadband Sound Level Difference, dB
Eastern Façade	GF	Office Hours Day (09:00 – 17:00)	57 $L_{Aeq,8hr}$	40 $L_{Aeq,8hr}$	17
	1		56 $L_{Aeq,8hr}$		16
	2		55 $L_{Aeq,8hr}$		15
	3		55 $L_{Aeq,8hr}$		15
	4		54 $L_{Aeq,8hr}$		14
	5		53 $L_{Aeq,8hr}$		13
Western Façade	1	Office Hours Day (09:00 – 17:00)	57 $L_{Aeq,8hr}$	40 $L_{Aeq,8hr}$	17
	2		57 $L_{Aeq,8hr}$		17
	3		56 $L_{Aeq,8hr}$		16
	4		55 $L_{Aeq,8hr}$		15
	5		54 $L_{Aeq,8hr}$		14

5.2 Ventilation Acoustic Requirements

It is proposed to use a system of Variable Refrigerant Flow (VRF) as a means of ventilation along with natural ventilation system of openable windows throughout the development.

To achieve appropriate internal ambient noise levels within offices, the standard ventilation rates should be achieved with windows closed.

Ventilation system noise levels in offices should be designed to achieve the noise limits set out in table 3.

5.3 Building Envelope Sound Reduction Requirements

The results of the noise monitoring exercise are also used to assess the sound insulation requirements of the building envelope, namely the external glazing, walls and roof.

The glazing and ventilation elements are typically the weakest acoustic link in the construction of a building façade. Considering the relatively low external levels and therefore the relatively low minimum required sound level difference, standard double glazing achieving minimum thermal requirements is expected to meet the target internal ambient noise levels (IANL) on the proposed new build extension of 4th and 5th floor of the development by default.

Assuming that the refurbishment of the lower floors is only internal, no responsibility should be taken for the internal ambient noise levels throughout these floors. It is our understanding that the existing single pane windows within the existing development are not to be replaced. As long as the ventilation strategy is designed to meet the target IANL criteria, the IANL levels in open plan offices throughout the refurbished floors will not exceed the current ones and should therefore be considered acceptable without any further mitigation.

It should be noted that by achieving IANL of 40 dB $L_{Aeq,T}$, NR40 $L_{Aeq,T}$ is likely to be achieved by default, effectively achieving the BCO requirements for an open plan office.

6 Noise Impact Assessment

This section of the report describes the impact from any items of plant associated with the proposed development on the nearest noise-sensitive receptors.

The limits below apply to the total sound emission level from all static plant and processes within the proposed development. Individual plant items may need to be designed to a lower limit such that the overall total achieves the stated criteria above. Should the proposed plant items be found to be tonal, or impulsive in nature (so as to attract attention), a penalty should be applied to the above limits.

From latest information it is our understanding that the proposed plant will be installed on the roof of the proposed office buildings. Since the precise location of the proposed plant is yet unknown, as a worst-case a calculation with the plant at the nearest edge of the roof of the building had been undertaken in terms of its impact on commercial receptors to the west and to the east as well as residential receptors at 7 Warwick Court to the north-west.

6.1 Nearest Commercial Sensitive Receptors

The shortest distance between the boundaries of the two buildings at either side of the development is 10 metres.

Table 11 below presents the calculation assessment of the maximum permissible sound power level for all proposed external plant, and assuming a hemi-spherical spreading given its proposed location in relation to the receptors.

Table 11: Maximum Permissible Proposed External Plant Sound Power Levels impacting Commercial Receptors

Office Hours (09:00 – 17:00) L_{A90}	Maximum Office Hours (09:00 – 17:00) Rating Level	Maximum Office Hours (09:00 – 17:00) Total Sound Power Level of roof mounted plant
48	53	74

6.2 Nearest Residential Sensitive Receptor

The nearest noise sensitive receptor is located at 7 Warwick Court at 11 meters north-west of the proposed development.

The lowest Daytime and Night-time L_{A90} levels monitored at Position 2 have been used for this assessment as they are representative of the existing noise levels at the residential receptors at 7 Warwick Court. The below levels are based on the Local Authority requirements of achieving a Rating Level of 10 dB below the lowest L_{A90} levels. They do not however consider the possibility of a tonal noise aspect, in which case, the maximum permissible proposed external plant sound power levels would have to be reduced by additional 5 dB.

Table 12: Maximum Permissible Proposed External Plant Sound Power Levels impacting Residential Receptors			
Period	Measured Existing Background Levels L_{A90}	Maximum Rating Level at Receiver	Maximum Total Sound Power Level of roof mounted plant
Weekday Daytime (07:00 – 23:00)	46	36	54
Weekday Office Hours (09:00 – 17:00)	54	44	65
Weekday Night-time (23:00 – 07:00)	44	34	52
Weekend Daytime (07:00 – 23:00)	46	36	54
Weekend Night-time (23:00 – 07:00)	45	35	53

The maximum permissible proposed external plant sound power levels has been found to be driven by the requirements for noise emission impacts at the residential receptors rather than the commercial ones. It should be noted that by achieving the noise limits in Table 12 above based on the Local Authority requirements, the noise limits in Table 11 set out for PoI 05 will be achieved at the commercial receptor by default.

It should be noted that this is based on an absolute worst-case scenario, should any plant be installed at the nearest boundary of the proposed development. By implementing a smart design and assembling all noise generating plant items towards the southern boundary of the development or by providing plant screening, the maximum permissible sound power levels for any plant items could be significantly increased.

6.3 Practical Control Measures

Screening of any external plant as well as provision of sound attenuators to items of plant may be necessary to control the transmission of sound and achieve the above criteria as well as to reduce the sound level produced by the plant to a reasonable extend around the footprint of the building itself.

Environmental attenuators and possibly other means of sound mitigation such as acoustic louvres or acoustic screens may be required to control sound emanating from the plantrooms, air intake and discharge points or from externally mounted plant.

Locating the future plant installation as far as possible from the nearest noise-sensitive receptor and using the proposed building to screen any future plant items would to ensure compliant emissions sound levels.

7 Construction Noise and Vibration Assessment

7.1 Potential Demolition and Construction Impacts

Noise and vibration levels generated by construction activities have the potential to impact upon nearby noise-sensitive receptors; however the magnitude of the potential impact would depend upon the type of activity; periods of operation; source to receiver distance; ground absorption and reflections.

There are many buildings in close proximity to the proposed development and therefore it will be important to consider noise mitigation measures during the demolition and construction processes.

7.2 Construction Noise Limits

According to the ABC method for assessing the significant effects from construction noise, in BS5228 "Code of practice for noise and vibration control on construction and open sites – Part 1: Noise", if the ambient noise level exceeds the threshold values given in Table 1: "Construction Noise Impact Significance Criteria" (i.e. the ambient noise level is higher than these values), then a significant effect is deemed to occur if the total L_{Aeq} noise level for the period increases by more than 3 dB due to construction activity.

Based on the measured ambient noise levels as presented in Tables 7-9, the total noise level, including construction, should be limited to the values below.

Table 13: Proposed Noise Limits During Construction at the Nearest Noise Sensitive Receiver

Location	Period	Measured Ambient Noise Level – dB L_{Aeq}	BS5228 Construction Noise Limit dB L_{Aeq}
All façades	Daytime	51	65

Note: it is assumed at this stage that the majority of construction works will occur during normal daytime hours.

7.3 Mitigation Measures / Best Practicable Means

The noise and vibration predictions indicate that significant adverse impact on the nearest sensitive receiver should be avoided. The following sets out best practice measures in which the site emissions can be controlled.

Effective co-ordination and time management of construction operations would be important in avoiding noise and vibration nuisance to surrounding uses. Early and helpful communications with the surrounding receptors would assist reducing potential for and in managing any complaints arising during the construction works.

Contractors would be required to ensure that works are carried out in accordance with Best Practicable Means as stipulated in the Control of Pollution Act 1974. A full explanation of measures to control construction noise would normally be incorporated within a CEMP and detailed in all demolition and construction method statements.

The proposals in regard to general noise and vibration mitigation would be in accordance with BPM as specified in BS5228 and would comprise the following, where possible:

- Good communication with the adjacent residents is required, especially during periods of high vibration;
- Using 'silenced' plant and equipment;
- Switching off engines where vehicles are standing for a significant period of time;
- Fitting of acoustic enclosures to suppress noisy equipment as appropriate;
- Operating plant at low speeds and incorporating of automatic low speed idling;
- Selecting electrically driven equipment in preference to internal combustion powered, hydraulic power in preference to pneumatic and wheeled in lieu of tracked plant;
- Properly maintaining all plant (greased, blown silencers replaced, saws kept sharpened, teeth set and blades flat, worn bearings replaced, etc);
- Considering the use of temporary screening or enclosures for static noisy plant to reduce noise emissions as appropriate;
- Certifying plant to meet any relevant EC Directive standards; and
- Undertaking awareness training of all contractors in regards to BS5228 (Parts 1 and 2) which would form a prerequisite of their appointment.

Typically, adopting BPM would be expected to reduce overall construction noise levels by approximately 5 dBA.

Should any non-routine activities be identified that would make it impracticable to work to the target criterion, provisions would be set out in advance and with the agreement of the Local Authority, to reduce the effect.

8 Conclusion

MLM Consulting Engineers Ltd has been commissioned by Fulwood Place Limited to assess the impact of noise at the proposed development of Elizabeth House, 4-7 Fulwood Place, London, in respect of the site's suitability for office use.

The assessment has been based on detailed environmental noise measurements made at the proposed development site.

The suitability of the site for development of the proposed office usage has been based on the current development proposals and the measured noise levels, which has shown that the site will meet the requirements of the internal ambient noise levels for open plan offices with a standard double glazing.

The impact of building services noise emissions have been assessed to provide adverse impact in relation to the nearest residential noise-sensitive receptor in line with BS4142:2014 as well as to the nearest commercial receptor in line with BREEAM POL05. Similarly, construction noise has been considered and noise limits are provided to avoid adverse impact on surrounding receptors.

Where predicted levels indicate that noise may be a determining factor in the granting of planning permission, mitigation measures have been considered to ensure satisfactory conditions are met.

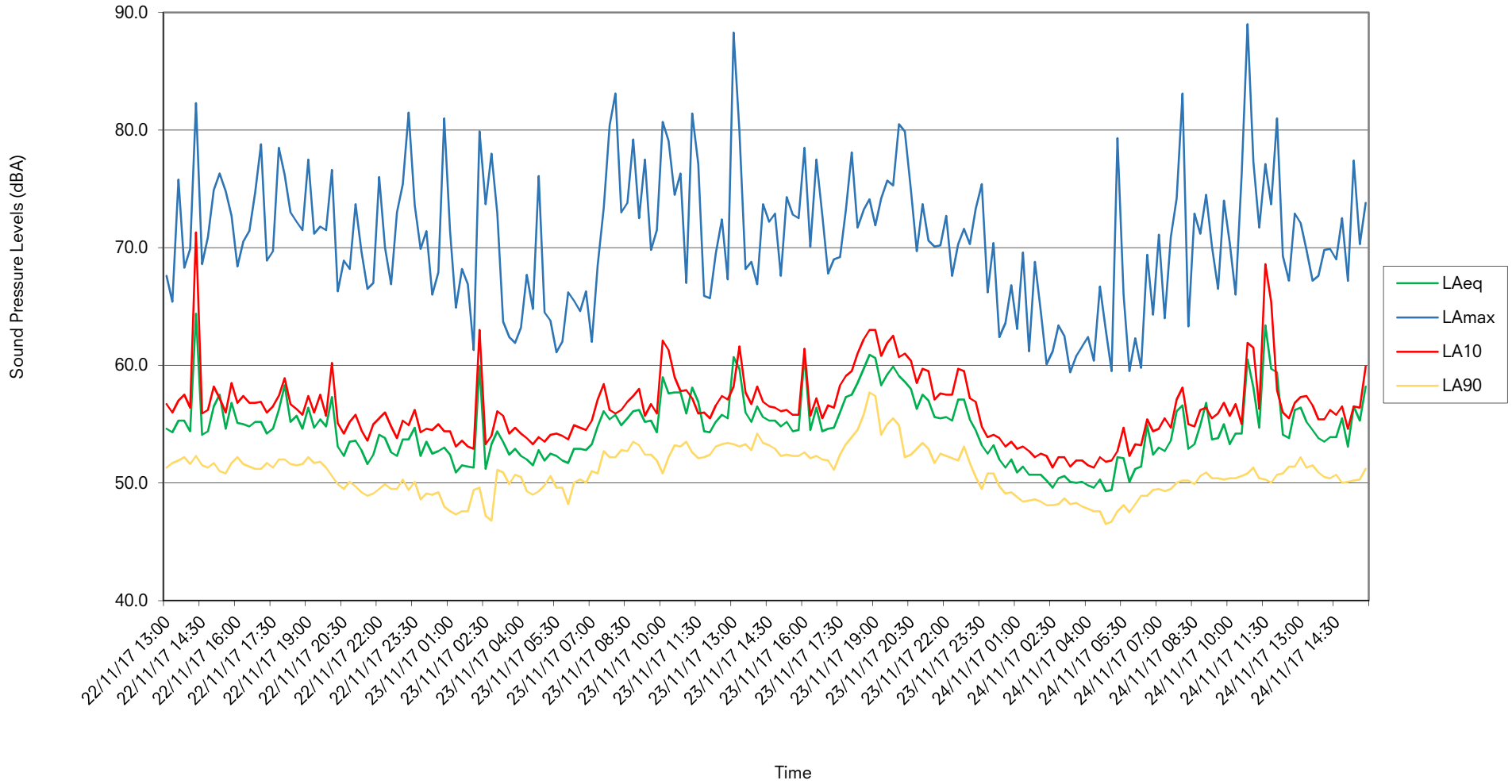
In the light of the findings of this report, it is considered that noise should not present a constraint to the granting of planning permission for office development at this site.

Appendix A - Glossary of Acoustic Terminology

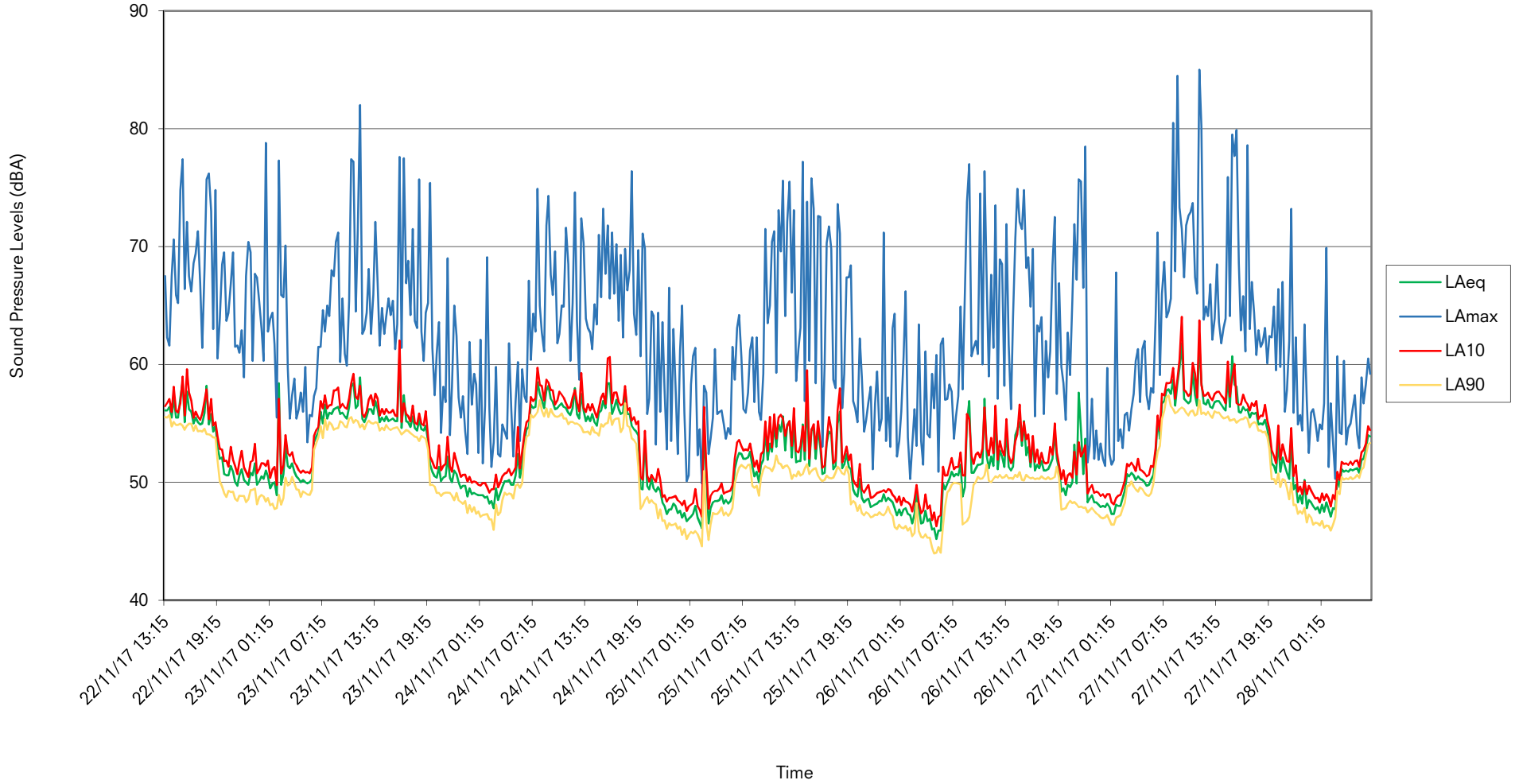
Wording	Description
Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20μPa (20x10-6 Pascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1 / s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
Leq,T	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
Lmax,T	A noise level index defined as the maximum noise level during the period T. Lmax is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L90,T	A noise level index. The noise level exceeded for 90% of the time over the period T. L90 can be considered to be the "average minimum" noise level and is often used to describe the background noise.
L10,T	A noise level index. The noise level exceeded for 10% of the time over the period T. L10 can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m
Facade	At a distance of 1m in front of a large sound reflecting object such as a building façade.
Fast Time Weighting	An averaging time used in sound level meters. Defined in BS 5969.

Appendix B - Noise Measurements

Elizabeth House, Fulwood Place, London
Microphone Position 1
Measured LAeq, LAMax, LA10 & LA90 Time Histories
22/11/17 - 24/11/17



Elizabeth House, Fulwood Place, London
Microphone Position 2
Measured LAeq, LAMax, LA10 & LA90 Time Histories
22/11/17 - 28/11/17



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