Arthur Stanley House
Planning Noise and Vibration Report

Westbrook Partners / 1921 Mortimer Investments Limited

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SANDY BROWN

Consultants in Acoustics, Noise & Vibration

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Arthur Stanley House, London

Planning noise and vibration report

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A	16 Jun 17		Aaron Tomlinson	Bob Albon
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D	18 Jul 17	Incorporating comments	Aaron Tomlinson	Bob Albon
E	8 Dec 17	Updated Figure 2	Aaron Tomlinson	Jason Swan

Summary

Sandy Brown has been commissioned by Green Building Design Consultants by instruction of 1921 Mortimer Investments Ltd to provide acoustic advice in relation to the proposed refurbishment of Arthur Stanley House, Tottenham Street, London.

An environmental noise survey has been carried out to determine the existing noise climate in the area. The results of the noise survey will be used to set appropriate plant noise limits in line with the requirements of Camden Council, and inform the requirements of the facade with regard to sound insulation.

The noise survey was performed between 11:00 Thursday 1 June 2017 and 14:45 on Monday 5 June 2017.

The representative background sound levels measured during the survey were $L_{A90,15min}$ 47 dB during the daytime and $L_{A90,15min}$ 43 dB at night.

Based on the requirements of Camden Council and on the results of the noise survey, all non-emergency plant must be designed such that the cumulative noise level at 1 m from the worst affected windows of the nearby noise sensitive premises does not exceed L_{Aeq} 37 dB during the daytime and L_{Aeq} 33 dB during the night.

Based on the requirements of Camden Council and on the results of the noise survey, emergency plant must be designed such that the cumulative operating noise level at 1 m from the worst affected window of the nearby noise sensitive premises does not exceed L_{Aeq} 57 dB during the daytime and L_{Aeq} 53 dB during the night. The standard noise egress criteria also apply during standby operation.

An initial assessment has been undertaken in order to set the overall sound insulation requirements of the facade areas for bedrooms and living spaces to achieve suitable internal noise levels. The most onerous facade sound insulation requirement is $R_w + C_{tr}$ 28 dB and will likely require 6/12/6 double glazing as a minimum when combined with attenuated passive trickle ventilators and a suitable construction to the remaining solid facade area.

The existing external an predicted internal noise levels, when considered with regard to the *Camden Local Plan Adopted version June 2017*, would place the development at the lower end of the 'Amber' category for external and internal noise levels.

A vibration survey was performed with objective of assessing the degree to which the proposed development will be affected by tactile vibration (with reference to BS 6472:2008 *Evaluation of Human Exposure to Vibration in Buildings – Part 1: Vibration from sources other than blasting*) and re-radiated noise from train movements on the underground in the local area.

The highest predicted vibration dose values are 0.013 $m/s^{1.75}$ during the 16 hour daytime (07:00-23:00), and 0.01 $m/s^{1.75}$ during the 8 hour night time (23:00-07:00).

During the ground-borne noise measurements, no significant vibration events were observed. The highest predicted re-radiated L_{ASmax} level for all of these events was 21 dB.

Tactile vibration and structure-borne noise are not considered to be an issue at this site.

Contents

1 Introduction

Sandy Brown has been commissioned by Green Building Design Consultants by instruction of 1921 Mortimer Investments Ltd to provide acoustic advice in relation to the proposed refurbishment of Arthur Stanley House, Tottenham Street, London.

An environmental noise survey has been carried out, the purpose of which was to establish the existing ambient and background sound levels in the vicinity of the site and nearby noise sensitive premises in order to inform the specification for the facade sound insulation and to set appropriate plant noise limits in line with the requirements of Camden Council.

The background sound levels measured during the survey are used as the basis for setting limits for noise emission from proposed building services plant. These limits are set in accordance with the requirements of Camden Council.

The facade sound insulation is assessed in order to determine the necessary performance required to achieve appropriate internal noise levels for residences set in accordance with BS 8233:2014 *Sound insulation and noise reduction for buildings*, and World Health Organisation guidelines.

A vibration survey was performed with objective of assessing the degree to which the proposed development will be affected by tactile vibration (with reference to BS 6472:2008 *Evaluation of Human Exposure to Vibration in Buildings – Part 1: Vibration from sources other than blasting*) and re-radiated noise from train movements along the railway tracks adjacent to the site.

This report presents the following:

- Noise and vibration survey methods
- Results of the surveys
- A discussion of acceptable limits for noise emission from building services plant
- Minimum sound insulation requirements for the residential building envelope
- A discussion of the vibration results with regard to vibration dose values, and ground borne re-radiated noise levels

2 Development proposal

Arthur Stanley House is an existing building which is understood to have been used previously as a hospital building. It is proposed that the existing building will be refurbished to provide office accommodation, and an extension will be constructed along Tottenham Mews, appended to the proposed office building, to provide residential accommodation.

3 Site description

3.1 The site and its surrounding

The site location in relation to its surroundings is shown in Figure 1.

The proposed office portion of the site is indicated in blue, and the proposed residential in green.

The site is located on the corner of Tottenham Street and Tottenham Mews, London, approximately 200 m south of the BT Tower.

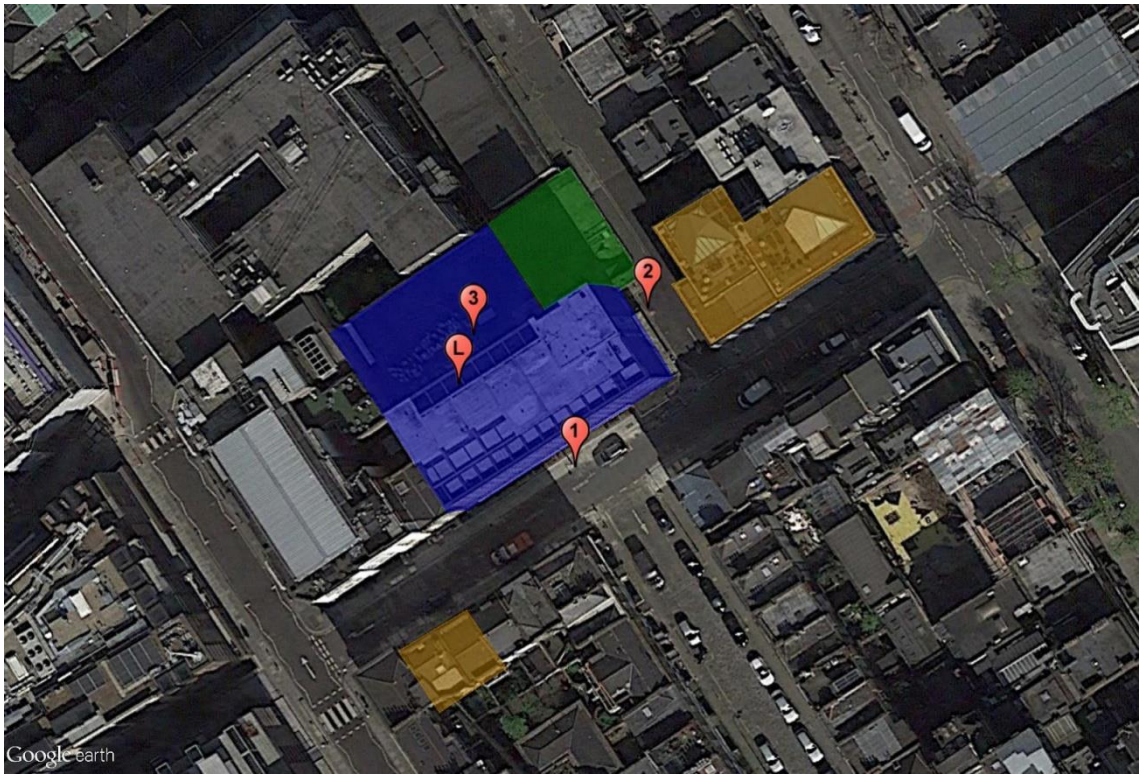


Figure 1 Site map (courtesy of Google Earth Pro)

3.2 Adjacent premises

The building is connected to existing retail premises to the southwest along Tottenham Street and commercial premises along Tottenham Mews.

Other adjacencies include residential and retail premises along Tottenham Street. Residential premises have been identified along Tottenham Mews along with commercial and retail units.

The nearest noise sensitive residential receptors are highlighted in orange in Figure 1.

4 Method

Details of the equipment used, the noise indices measured and the weather conditions during the survey are provided in Appendix A. Further information on the survey method is provided in this section.

4.1 Unattended measurements

Unattended noise monitoring was undertaken at the site over 5 days to determine the existing noise climate. The measured background sound levels are considered reasonably representative of those in the vicinity of nearby noise sensitive premises.

The unattended measurements were performed over 15 minute periods between 11:00 on Thursday 1 June 2017 and 14:45 on Monday 5 June 2017. The equipment was installed by Jessica Wright and Francis Goodall, and collected by Jessica Wright.

The measurement position used during the survey is indicated in Figure 1, denoted by the letter 'L'. This location was chosen to be reasonably representative of the noise levels experienced by the nearest noise sensitive premises as well as indicative of ambient noise levels in a location screened from local road traffic.

At the unattended noise monitoring location, the microphone was positioned on the rooftop of the existing building overlooking the courtyard along Tottenham Mews. The microphone was at least 3 m from the nearest significant reflective vertical surface. Measurements at this location are considered free-field.

4.2 Attended measurements

Attended sample measurements were performed by Jessica Wright and Kristina Hinova at a number of locations around the site. These are indicated in Figure 1 as positions 1 to 3. Attended measurements were carried out on Thursday 1 June 2017 and Monday 5 June 2017, with the purpose of determining the existing noise levels from road traffic, pedestrians and other significant noise sources in the area.

Attended measurements were also carried out on Friday 9 June 2017 with the purpose of determining the existing noise levels during a morning rush hour.

The locations of the measurements are indicated in Figure 1. In each case the microphone was mounted on a tripod approximately 1.5 m above the ground level. At locations 1 and 3, the microphone was positioned at least 3 m from the nearest significantly reflective vertical surface and measurements at these locations are considered free-field. At location 2, the microphone was positioned approximately 1 m from the building facade and measurements at this location are considered facade measurements.

4.3 Vibration survey method

Vibration measurements were performed at 1 location in the basement of the site in order to determine if the site is affected by tri-axial vibration from the passage of trains on the underground lines in the local area.

For the vibration measurements, a single accelerometer was set up to measure vibration dose values (VDV) and 1/3 octave band slow weighted RMS acceleration. The VDV measurements were taken to establish levels of tactile vibration while the 1/3 octave band slow weighted RMS acceleration measurements were used for purposes of the re-radiated L_{ASmax} prediction.

The vibration measurements were undertaken on the suspended basement 1 slab as the basement 2 slab was below water level.

These measurements were performed on Monday 10 July 2017 at location 'V' as indicated on Figure 2. The measurements were performed by Francs Goodall.

The vibration measurements performed are considered to be reasonably representative of the vibration levels to be experienced by the proposed residential premises.

The accelerometers were fixed to the floor using beeswax, away from the boundaries of the room.

The vibration measurements were conducted in three axes.

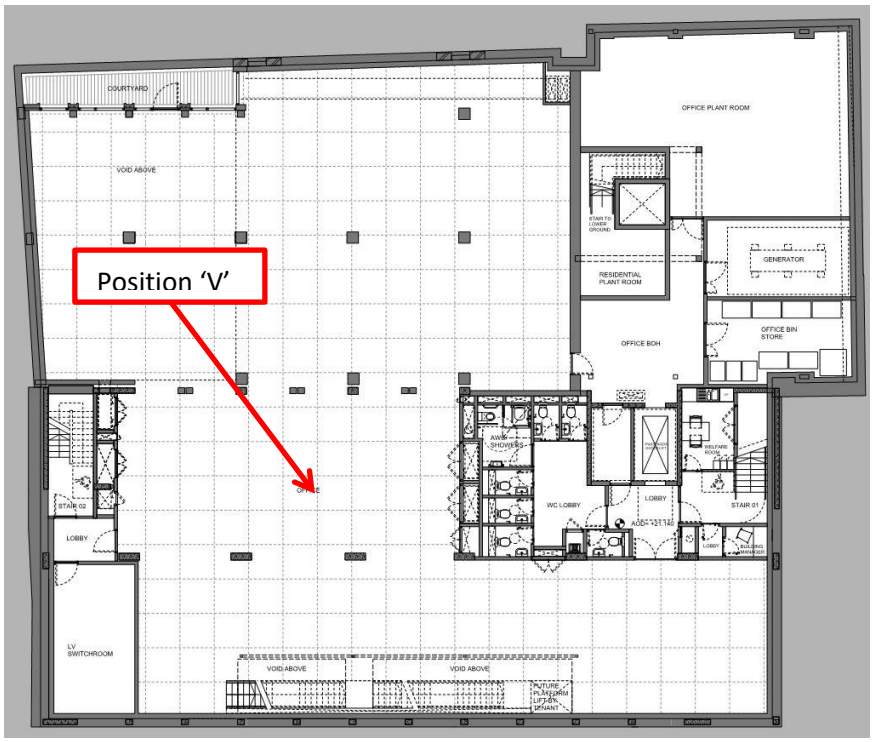


Figure 2 Basement B1 drawing indicating approximate vibration measurement position 'V'

5 Measurement results

5.1 Observations

The noise climate at the site consisted of infrequent road traffic, pedestrian noise, and activity noise from a loading bay along Tottenham Mews.

5.2 Unattended measurement results

The results of the unattended noise measurements are summarised in the following tables. A graph showing the results of the unattended measurements is provided in Appendix B.

The day and night time ambient noise levels measured during the unattended survey are presented in Table 1.

Table 1 Ambient noise levels measured during the survey

Date	Daytime (07:00 – 23:00) $L_{Aeq,16h}$ (dB)	Night (23:00 – 07:00) $L_{Aeq,8h}$ (dB)
Thursday 1 June 2017	-	46
Friday 2 June 2017	58	48
Saturday 3 June 2017	53	49
Sunday 4 June 2017	51	46
Average	54	47

The minimum background sound levels measured during the unattended survey are given in Table 2.

Table 2 Minimum background sound levels measured during the survey

Date	Daytime (07:00 – 23:00) $L_{A90,15min}$ (dB)	Night (23:00 – 07:00) $L_{A90,15min}$ (dB)
Thursday 1 June 2017	47*	43
Friday 2 June 2017	47	44
Saturday 3 June 2017	47	44
Sunday 4 June 2017	45	43
Monday 5 June 2017	48*	-

* Measurement not made over full period due to monitoring start and end time

The lowest background sound levels measured during the survey were $L_{A90,15min}$ 45dB during the daytime and $L_{A90,15min}$ 43 dB at night.

In line with BS 4142:2014, for the purpose of analysis and establishing representative background sound levels, day and night time typical levels have been quantified using statistical analysis from the continuous logging measurements.

Daytime and night time statistical analysis of representative values for the site are given in Figure 3 and Figure 4.

From this analysis, the representative background sound levels measured during the survey were $L_{A90,15min}$ 47 dB during the daytime and $L_{A90,15min}$ 43 dB at night.

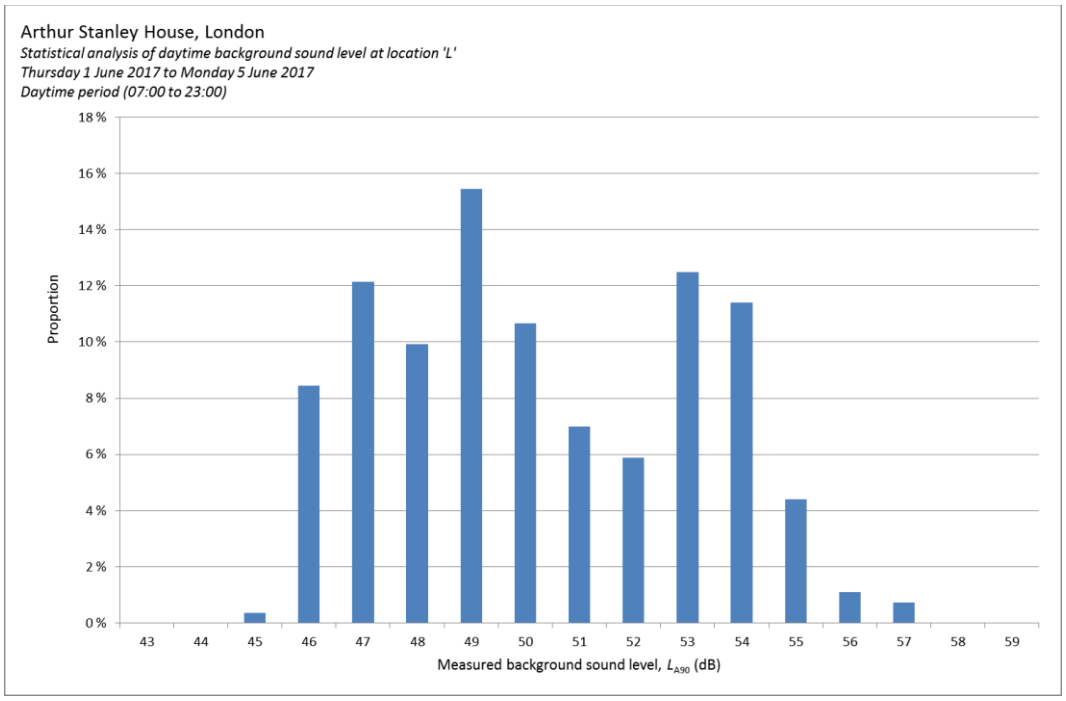


Figure 3 Statistical analysis of daytime background sound level at location 'L'

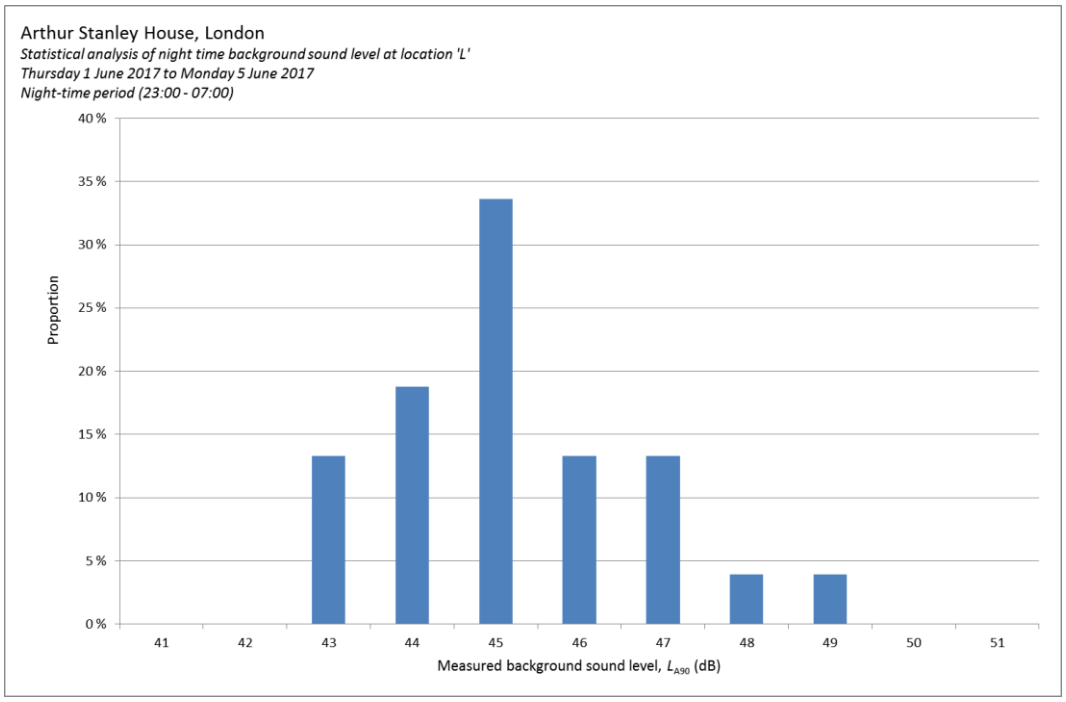


Figure 4 Statistical analysis of night time background sound level at location 'L'

5.3 Attended measurement results

The sound pressure levels recorded during the attended measurements are summarised in Table 3. All the attended measurements were performed over 15 minute periods.

Road traffic along Tottenham Street is infrequent but was noted to be the main typical source for the highest maximum noise levels at measurement positions 1 and 2. Road traffic along Charlotte Street and Tottenham Court Road was noted to be more significant than along Tottenham Street during peak traffic conditions.

Activity at a loading bay along Tottenham Mews was also noted to be a noise source at attended measurement positions 1 to 3.

Table 3 Sound pressure levels from attended measurements

Position	Date	Start time	Sound pressure levels (dB)		
			$L_{Aeq,15min}$	$L_{AFmax,15min}$	$L_{A90,15min}$
1	Thursday 1 June 2017	11:14	58	73	52
1	Friday 9 June 2017	08:23	59	85	51
		08:43	58	76	51
		09:15	56	71	51
		09:45	60	82	51
2	Thursday 1 June 2017	11:30	61	81	52
	Monday 5 June 2017	14:00	58	77	52
2	Friday 9 June 2017	08:59	57	72	52
		09:30	60	85	52
		10:01	58	79	51
3	Monday 5 June 2017	14:30	52	69	49
		14:45	55	76	51

5.4 Vibration measurement results

5.4.1 Tactile vibration measurements

The following table presents the vibration dose values measured at location 'V'. These measurements were performed on Monday 10 July 2017 and are considered representative of the vibration levels to be experienced by the proposed residential development. The maximum vibration dose values measured for each of the directions are highlighted in red.

During the measurements, no specific vibration events were noted. However, it is understood that trains were running as normal along the underground train lines nearby the site.

Table 4 Vibration dose values measured at location 'V'

Start time	Duration (min)	VDV ($m/s^{1.75}$)		
		X	Y	Z
16:22	5	0.0004	0.0004	0.0026
16:27	5	0.0005	0.0004	0.0031
16:33	5	0.0004	0.0004	0.0035
16:38	5	0.0003	0.0003	0.0024
16:43	5	0.0003	0.0003	0.0027

5.4.2 Re-radiated noise measurements

Ground-borne noise within the proposed development was predicted using an empirical formula described in '*Guidelines for the Measurement & Assessment of Groundborne Noise and Vibration (2nd Edition)*' published by the Association of Noise Consultants in 2012.

The predicted re-radiated noise level, from the vibration measurements at location 'V', as indicated on Figure 2, are presented in the following table in terms of L_{ASmax} as required by BS 6472.

Table 5 Predicted re-radiated noise levels from vibration measurements at location 'V'

Vibration location 'V'		
Start time	Duration (min)	L_{ASmax} (dB)
16:22	5	19
16:27	5	19
16:33	5	19
16:38	5	21
16:43	5	20

6 Assessment criteria

6.1 NPPF and NPSE

The National Planning Policy Framework (NPPF) sets out the government planning requirements, and supersedes previous guidance notes such as PPG24. No specific noise criteria are set out in the NPPF, or in the Noise Policy Statement for England (NPSE) to which it refers.

The 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 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.'*

The NPSE states that its aims are as follows:

'Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- *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.'*

As such, although neither of these documents sets out specific acoustic criteria for new residential development, the requirement to control both the effect of existing noise on the new development and the effect of noise from the development on the surroundings needs to be considered.

6.1.1 Local authority guidance

Camden Council provide objective limits for external noise levels at the facades of noise sensitive developments within their document *Camden Local Plan Adopted version June 2017*. A screenshot of the relevant section is provided below.

Dominant Noise Source	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAEL (Red)
Anonymous noise such as general environmental noise, road traffic and rail traffic ~	Noise at 1 metre from noise sensitive façade/free field	Day	<50dB$L_{Aeq,16hr}$*	50dB to 72dB$L_{Aeq,6hr}$*	>72dB$L_{Aeq,16hr}$*
		Night	<45dB$L_{Aeq,8hr3}$ <40 dB$L_{Aeq,8hr}$**	45dB to 62dB$L_{Aeq,8hr}$* >40dBL_{night}**	>62dB$L_{Aeq,8hrs}$*
	Inside a bedroom	Day	<35dB$L_{Aeq,16hr}$	35dB to 45dB$L_{Aeq,16hr}$	>45dB$L_{Aeq,16hr}$
		Night	<30dB$L_{Aeq,8hr}$ 42dB$L_{Amax,fast}$	30dB to 40dB$L_{Aeq,16hr}$ 40dB to 73dB$L_{Amax,fast}$	>40dB$L_{Aeq,8hr}$ >73dB$L_{Amax,fast}$
	Outdoor living space (free field)	Day	<50dB$L_{Aeq,16hr}$	50dB to 55dB$L_{Aeq,6hr}$	>55dB$L_{Aeq,16hr}$
Non-anonymous noise	See guidance note on non-anonymous noise				

*LAeq, T values specified for outside a bedroom window are façade levels
**Lnight values specified for outside a bedroom window are free field levels

The NOEL, LOAEL, and SOAEL definitions are reproduced below from the *Camden Local Plan Adopted version June 2017*:

> '*NOEL – No observed effect level*
> *LOAEL – Lowest observed adverse effect level*
> *SOAEL – Significant observed adverse effect level'*

And the definitions of each design category are reproduced below:

> '*Green – Where noise is considered to be at an acceptable level*
> *Amber – Where noise is observed to have an adverse effect level, but which may be considered acceptable when assessed in the context of other merits of the development.*
> *Red – Where noise is observed to have a significant adverse effect.'*

6.2 External noise levels – noise egress

6.2.1 Standard guidance

Guidance for noise emission from proposed new items of building services plant is given in BS 4142: 2014 '*Methods for rating and assessing industrial and commercial sound*'.

BS 4142 provides a method for assessing noise from items such as building services plant against the existing background sound levels at the nearest noise sensitive.

BS 4142 suggests that if the noise level is 10 dB or more higher than the existing background sound level, it is likely to be an indication of a significant adverse impact. If the level is 5 dB above the existing background sound level, it is likely to be an indication of an adverse impact. If the level does not exceed the background level, it is an indication of having a low impact.

If the noise contains 'attention catching features' such as tones, bangs etc, a penalty, based on the type and impact of those features, is applied.

6.2.2 Camden Council criteria – Non-emergency plant

The *Camden Local Plan Adopted version June 2017* document provides objective criteria in relation to noise egress from non-emergency plant. A screenshot of the relevant section is provided below.

Existing Noise sensitive receptor	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAL (Red)
Dwellings**	Garden used for main amenity (free field) and Outside living or dining or bedroom window (façade)	Day	'Rating level' 10dB* below background	'Rating level' between 9dB below and 5dB above background	'Rating level' greater than 5dB above background
Dwellings**	Outside bedroom window (façade)	Night	'Rating level' 10dB* below background and no events exceeding 57dBL_{Amax}	'Rating level' between 9dB below and 5dB above background or noise events between 57dB and 88dB L_{Amax}	'Rating level' greater than 5dB above background and/or events exceeding 88dBL_{Amax}

*10dB should be increased to 15dB if the noise contains audible tonal elements. (day and night). However, if it can be demonstrated that there is no significant difference in the character of the residual background noise and the specific noise from the proposed development then this reduction may not be required. In addition, a frequency analysis (to include, the use of Noise Rating (NR) curves or other criteria curves) for the assessment of tonal or low frequency noise may be required.

**levels given are for dwellings, however, levels are use specific and different levels will apply dependent on the use of the premises.

It is considered that a reasonable interpretation of the Camden Council requirements set out in the extract above, would be the use of representative noise levels determined as per BS 4142:2014.

6.2.3 Camden Council criteria – Emergency plant

The *Camden Local Plan Adopted version June 2017* document provides objective criteria in relation to noise egress from emergency plant. The wording from the relevant section is reproduced below.

> '*Emergency equipment such as generators which are only to be used for short periods of time will be required to meet the noise criteria of no more than 10 dB above the background level (L_{90} 15 minutes). During standby periods, emergency equipment will be required to meet the usual criteria for plant and machinery. Conditions to this effect may be imposed in instances where emergency equipment forms part of the application.'*

6.3 Internal noise level – noise ingress

6.3.1 Standard guidance

Guidance on acceptable internal noise levels in residential dwellings is given in BS 8233:2014 *Sound insulation and noise reduction for buildings*, and is also provided by the World Health Organisation. The guidance given by BS 8233 and WHO is shown in Table 6.

Table 6 Internal noise criteria for sleeping/resting

Internal space	Indoor ambient noise level L_{Aeq} (dB)		
	BS 8233 (07:00 to 23:00)	BS 8233 (23:00 to 07:00)	WHO
Living rooms	35	-	30/35[1]
Dining room	40	-	-
Bedrooms	35	30[2]	30[2]

[1] WHO does not differentiate between different types of living spaces, but recommends L_{Aeq} 30 dB in relation to sleep disturbance and L_{Aeq} 35 dB in relation to speech intelligibility. WHO provides a 16 hour time base when referring to speech intelligibility and an 8 hour time base when referring to sleep disturbance.

[2] BS 8233 notes that individual noise events can cause sleep disturbance, and that a guideline value may be set depending on the character and number of events per night, although no specific limit is provided. Section 3.4 of the WHO guidelines for community noise suggests that good sleep will not generally be affected if internal levels of L_{Amax} 45 dB are not exceeded more than 10-15 times per night.

6.3.2 Local Authority requirements

The *Camden Local Plan Adopted version June 2017* document contains objective criteria in relation to internal noise levels. An extract of the relevant section is provided below.

Dominant Noise Source	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAEL (Red)
Anonymous noise such as general environmental noise, road traffic and rail traffic ~	Noise at 1 metre from noise sensitive façade/free field	Day	<50dB$L_{Aeq,16hr}$*	50dB to 72dB$L_{Aeq,8hr}$*	>72dB$L_{Aeq,16hr}$*
		Night	<45dB$L_{Aeq,8hr3}$ <40 dB$L_{Aeq,8hr}$**	45dB to 62dB$L_{Aeq,8hr}$* >40dBL_{night}**	>62dB$L_{Aeq,8hrs}$*
	Inside a bedroom	Day	<35dB$L_{Aeq,16hr}$	35dB to 45dB$L_{Aeq,16hr}$	>45dB$L_{Aeq,16hr}$
		Night	<30dB$L_{Aeq,8hr}$ 42dB$L_{Amax,fast}$	30dB to 40dB$L_{Aeq,16hr}$ 40dB to 73dB$L_{Amax,fast}$	>40dB$L_{Aeq,8hr}$ >73dB$L_{Amax,fast}$
	Outdoor living space (free field)	Day	<50dB$L_{Aeq,16hr}$	50dB to 55dB$L_{Aeq,8hr}$	>55dB$L_{Aeq,16hr}$
Non-anonymous noise	See guidance note on non-anonymous noise				

*LAeq, T values specified for outside a bedroom window are façade levels
**Lnight values specified for outside a bedroom window are free field levels

6.4 Tactile vibration criteria

6.4.1 Standard guidance

Tactile vibration is that which is perceived as mechanical motion. BS 6472-1: 2008 *Guide to Evaluation of Human Exposure to Vibration in Buildings Part 1: Vibration Sources Other Than Blasting* provides procedures for assessing the potential human response to vibration.

Vibration is assessed in terms of the equivalent 'vibration dose value'. This relates the level and duration of vibration.

For information, the BS 6472-1: 2008 assessment table is reproduced below:

Table 7 BS 6472-1: 2008 tactile vibration assessment criteria

Vibration dose values ($m/s^{1.75}$) above which might result in various degrees of adverse comment within residential buildings.			
Place	Low probability of adverse comment	Adverse comment possible	Adverse comment probable
Residential buildings 16 hr day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential building 8 hr night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Note that offices and workshops, multiplying factors of 2 and 4 respectively should be applied to the above vibration dose value ranges for a 16 hr day.

It is important to note that people exhibit wide variations of vibration tolerance. Specific values are dependent upon social and cultural factors, psychological attitudes and expected degree of intrusion.

6.4.2 Local Authority requirements

The *Camden Local Plan Adopted version June 2017* provides objective criteria in relation to vibration dose values. A screenshot of the table from the relevant section is provided below.

Vibration description and location of measurement	**Period**	**Time**	**Vibration Levels (Vibration Dose Values)**
Vibration inside critical areas such as a hospital operating theatre	Day, evening and night	00:00-24:00	0.1 VDV ms-1.75
Vibration inside dwellings	Day and evening	07:00-23:00	0.2 to 0.4 VDV ms-1.75
Vibration inside dwellings	Night	23:00-07:00	0.13 VDV ms-1.75
Vibration inside offices	Day, evening and night	00:00-24:00	0.4 VDV ms-1.75
Vibration inside workshops	Day, evening and night	00:00-24:00	0.8 VDV ms-1.75

6.5 Re-radiated noise criteria

6.5.1 Standard guidance

There is currently no international or British Standard which provides guidance on assessing the impact of ground-borne noise from railways on the occupants of a building. The Association of Noise Consultants (ANC) guidelines '*Measurement and assessment of ground-borne noise and vibration*', 2nd edition published in 2012, is generally used as the basis of assessments such as this.

This document also provides discussion on the relevant research that has been carried out, and a summary of typically adopted criteria.

The most relevant items are set out below:

- The American Public Transit Association (APTA) guidelines recommend criteria of between 30 and 40 dB(A) depending on the density and type of residential properties. They do not define where within a building these apply, or the time response that should be used.
- The Federal Transit Administration (FTA) of the US Department of Transportation, recommends limits for maximum pass-by levels of 35 dB(A) for frequent events (more than 70 events per day) and 43 dB(A) for infrequent events.
- London Underground Limited has studied the relationship between ground-borne noise levels and complaint thresholds. This was used to define a complaint threshold of 40 dB L_{Amax}.
- The ANC guidelines also note that Local Authority guidelines for ground-borne noise were published in London and the South East, and state a limit of 35 dB L_{Amax}.

In all of the above examples, the time constant is not defined, with the exception of the Local Authority guidelines in London and the South East, which is defined as having a fast time weighting.

It should be noted that most of this research relates to residential accommodation, and is aimed at providing good sleeping / resting conditions.

6.5.2 Local Authority requirements

The *Camden Local Plan Adopted version June 2017* document does not contain objective criteria in relation to ground borne re-radiated noise levels.

7 Plant noise limits – noise egress

7.1 Basic limits

Based on the above criteria and the measurement results, the cumulative noise level resulting from the operation of all new non-emergency plant at 1 m from the worst affected windows of the nearest noise sensitive premises should not exceed the limits set out in Table 8.

Table 8 Plant noise limits at 1 m from the nearest noise sensitive premises

Time of day	Maximum sound pressure level at 1 m from noise sensitive premises ($L_{Aeq,15min}$ dB)
Daytime (07:00-23:00)	37
Night-time (23:0-07:00)	33

The limits set out in Table 8 do not include any attention catching features. The penalties for attention catching features will be significant, and will need to be considered as the building services design progresses.

7.2 Emergency plant limits

Based on the above criteria and the measurement results, the cumulative noise level resulting from the operation of all emergency plant at 1 m from the worst affected windows of the nearest noise sensitive premises should not exceed the limits set out in Table 9.

Table 9 Emergency plant noise limits at 1 m from the nearest noise sensitive premises

Time of day	Maximum sound pressure level at 1 m from noise sensitive premises ($L_{Aeq,15min}$ dB)
Daytime (07:00-23:00)	57
Night-time (23:00-07:00)	53

The limits set out in Table 9 apply when emergency plant is in operation. During standby periods, the limits set out in Table 8 are applicable.

7.3 Assessment

At this stage, no information is available in relation to the proposed installation of building services plant, and this will need to be assessed in detail as the design progresses. However, all plant items will be designed to achieve the plant noise limits set out above, including any corrections for attention catching features.

8 Facade sound insulation – noise ingress

This section discusses internal noise level criteria and assesses the required facade sound insulation performance. In principle, the required facade specification depends on two factors – the external noise levels at the site, and the internal noise criteria.

8.1 External noise levels

The external noise levels at the site are outlined in Table 10. The night time levels are predicted based on the measurement results.

Table 10 Daytime and predicted night time facade noise level at residential building

Facade location	Ambient noise level, L_{Aeq} (dB)		Predicted night time maximum noise levels, L_{AFmax} (dB) (23:00-07:00)	
	Daytime (07:00-23:00)	Predicted night time (23:00-07:00)	Highest event	Typical event (based on the 10th highest maximum noise event)
Front	61	57	83	68
Rear	50	37	73	58

With regard to the *Camden Local Plan Adopted version June 2017* as discussed in section 6.1.1 these external noise levels are below the SOAEL levels, and above the LOAEL levels so are within the 'Amber' category.

The *Camden Local Plan Adopted version June 2017* defines the 'Amber' category as follows:

> *'Amber – where noise is observed to have an adverse effect level, but which may be considered acceptable when assessed in the context of other merits of the development.'*

Notwithstanding this the external noise levels are not considered to be high for an urban location and subject to appropriate facade design is suitable for residential development.

In order to allow an assessment of the worst case scenario, the highest ambient noise levels, and the typical night time maximum noise levels provided in Table 3 have been used to assess noise ingress, and determine the facade performances necessary to achieve suitable internal noise levels.

8.2 Facade sound insulation

The percentage facade areas of glazing vary throughout the design and are generally between 25-75% of the total facade area for the bedrooms and living rooms. The glazing, along with trickle ventilators (should the use of these be sought) and balcony doors will be the weakest elements in the facade with regard to sound insulation.

The facade sound insulation performance requirements are based on achieving the guideline internal noise levels as per BS 8233:2014 and WHO given in section 6.3, to provide suitable internal noise levels within the residences. These noise levels, with regard to the *Camden Local Plan Adopted version June 2017*, would be below the SOAEL and above the LOAEL, placing the development at the lower end of the 'Amber' category for internal noise levels.

The minimum sound insulation performances for the different building facades are given in Table 11.

Table 11 Facade sound insulation performance requirements

Facade	Overall sound insulation performance $R'_w + C_{tr}$ (dB)
Along Tottenham Mews – Basement level (bedrooms)	22
Overlooking Tottenham Mews – Ground floor and above (bedrooms)	28
Overlooking Tottenham Mews – Ground floor and above (living rooms)	26
Overlooking rear of site – First floor (bedrooms)	20
Overlooking rear of site – Second and third floor (bedrooms)	25

8.3 Guidance on facade construction, glazing, and ventilation strategy

The following table sets out some examples of glazing build ups and ventilation strategies that could be employed to achieve the required sound insulation performance for the various elevations.

Table 12 Example glazing configurations and ventilation strategies

Sound insulation R_w+C_{tr} (dB)	Example glazing configuration	Ventilation Strategy
15-29	6 mm/12 mm/6 mm	Attenuated passive ventilation (eg, trickle vents)

The performance required by each element will depend on the construction of the solid elements, the glazing specification, the relative areas of the solid and glazed elements, and the ventilation strategy (including the acoustic performance of the trickle ventilators and the number of ventilators required to serve individual rooms, if applicable).

As the design progresses, a more detailed facade sound insulation assessment will need to be performed, taking into account the factors listed above, to ensure that the overall performance requirements will be met.

9 Vibration assessment

9.1 Tactile vibration

BS 6472 states that the assessment should be based on the axis along which the highest vibration dose value (VDV) is measured. At measurement location 'V', the highest vibration dose value was measured on the Z axis.

On the basis that no specific vibration events were noted during the measurements, as a worst case scenario it has been considered that the highest measured VDVs would persist throughout the daytime and night time. The assessment is undertaken on this basis and as such the equivalent vibration dose values over a 16 hour day and an 8 hour night are given in the following table.

Table 13 Equivalent vibration dose values

Location	Maximum VDV measured ($m/s^{1.75}$)	Equivalent VDV ($m/s^{1.75}$)	
		Daytime (07:00 – 23:00)	Night time (23:00 – 07:00)
Basement level bedroom	0.0035	0.013	0.01

By comparing the calculated day and night time vibration dose values above with the assessment table given in section 6.4 of this report, it can be seen that the predicted vibration dose values during the daytime and night periods are lower than the threshold of the 'low probability of adverse comment' category and below the limits in the *Camden Local Plan Adopted version June 2017*.

Levels experienced may vary depending on the type of train and position of the future buildings. However, it the measured vibration levels are below the lowest BS 6472 threshold, and a significant increase in the number of trains would be required for the threshold to be exceeded. Tactile vibration resulting from trains is therefore not considered to be problematic at this site.

9.2 Re-radiated noise

During the ground-borne noise measurements, no significant vibration events were observed. The highest predicted L_{ASmax} level for all of these events was 21 dB.

Of the levels measured during the survey period, all of the predicted levels were significantly lower than the criteria adopted by the recent UK rail projects discussed in Section 6.5.

On this basis, ground-borne noise in the proposed residences is unlikely to result in adverse comment. As the predicted values are for worst case floor conditions, noise levels from this source are expected to be lower at upper floor levels.

10 Conclusion

A noise survey has been carried out to determine the existing noise climate in the vicinity of the site and surrounding noise sensitive premises. The representative background sound levels were $L_{A90,15min}$ 47 dB during the day, and $L_{A90,15min}$ 43 dB during the night.

The key noise sources at the site were noted to be road traffic along Charlotte Street and Tottenham Court Road during rush hour, with maximum noise events resulting from infrequent traffic along Tottenham Street. Loading bay activity noise along Tottenham Mews, and distant construction noise were also noted to contribute to the noise climate at the site.

On the basis of the requirements of Camden Council, the non-emergency plant noise limits at the worst affected existing noise sensitive premises would be L_{Aeq} 37 dB during the day, and L_{Aeq} 33 dB during the night.

These limits are cumulative, and apply with all plant operating under normal conditions. If plant items contain tonal or attention catching features, the limits will be more stringent than those set out above. If plant items contain tonal or attention catching features, a penalty based on the type and impact of those features will be applied in line with the requirements of Camden Council, and the limits will be more stringent than those set out above.

On the basis of the requirements of Camden Council the emergency plant noise limits at the worst affected existing noise sensitive premises would be L_{Aeq} 57 dB during the daytime and L_{Aeq} 53 dB during the night. The standard egress criteria also apply during standby.

An initial assessment has been undertaken in order to set the overall sound insulation requirements of the facade areas for bedrooms and living spaces. The most onerous facade sound insulation requirement is $R_w + C_{tr}$ 28 dB and will likely require 6/12/6 double glazing as a minimum when combined with attenuated passive trickle ventilators and a suitable construction to the remaining solid facade area.

Tactile vibration and structure borne noise are not considered to be an issue at this site.

Appendix A

Survey details

Equipment

A Rion NL-52 sound level meter was used to undertake the unattended measurements. The attended measurements were carried out using a Bruel & Kjaer 2250 sound level meter. The calibration details for the equipment used during the survey are provided in Table A1.

Table A1 Equipment calibration data

Equipment description	Type/serial number	Manufacturer	Calibration expiry	Calibration certification number
Sound level meter	NL-52/00242704	Rion	7 Jun 18	1606292
Microphone	UC-59/06187	Rion	7 Jun 18	1606292
Pre-amp	NH-25/32732	Rion	7 Jun 18	1606292
Calibrator	CAL200/4501	Larson Davis	23 May 18	1605268
Sound level meter	2250/3011096	Bruel & Kjaer	16 Mar 19	UCRT17/1150, UTRC17/1152
Microphone	4189/3060575	Bruel & Kjaer	16 Mar 19	UCRT17/1150, UTRC17/1152
Pre-amp	ZC0032/25430	Bruel & Kjaer	16 Mar 19	UCRT17/1150, UTRC17/1152
Calibrator	4231/3017675	Bruel & Kjaer	10 Mar 19	UCRT17/1122
Data Recorder	DA-20/10870889	Rion	7 Sep 17	TCRT15/1252
Accelerometer	PV-87/33827	Rion	8 Sep 17	1509496
Accelerometer	PV-87/33828	Rion	8 Sep 17	1509497
Accelerometer	PV-87/33829	Rion	8 Sep 17	1509498
Vibration Calibrator	AT01/3015	AP Technology	8 Sep 17	1509495

Calibration of the sound level meters used for the tests is traceable to national standards. The calibration certificates for the sound level meters used in this survey are available upon request.

The sound level meters and microphones were calibrated at the beginning and end of the measurements using their respective sound level calibrators. No significant deviation in calibration occurred.

Noise indices

The equipment was set to record a continuous series of broadband sound pressure levels. Noise indices recorded included the following:

- $L_{Aeq,T}$ The A-weighted equivalent continuous sound pressure level over a period of time, T.
- $L_{AFmax,T}$ The A-weighted maximum sound pressure level that occurred during a given period with a fast time weighting.
- $L_{A90,T}$ The A-weighted sound pressure level exceeded for 90% of the measurement period. Indicative of the background sound level.

The L_{A90} is considered most representative of the background sound level for the purposes of complying with any local authority requirements.

Sound pressure level measurements are normally taken with an A-weighting (denoted by a subscript 'A', eg L_{A90}) to approximate the frequency response of the human ear.

A more detailed explanation of these quantities can be found in BS7445: Part 1: 2003 *Description and measurement of environmental noise, Part 1. Guide to quantities and procedures.*

Weather conditions

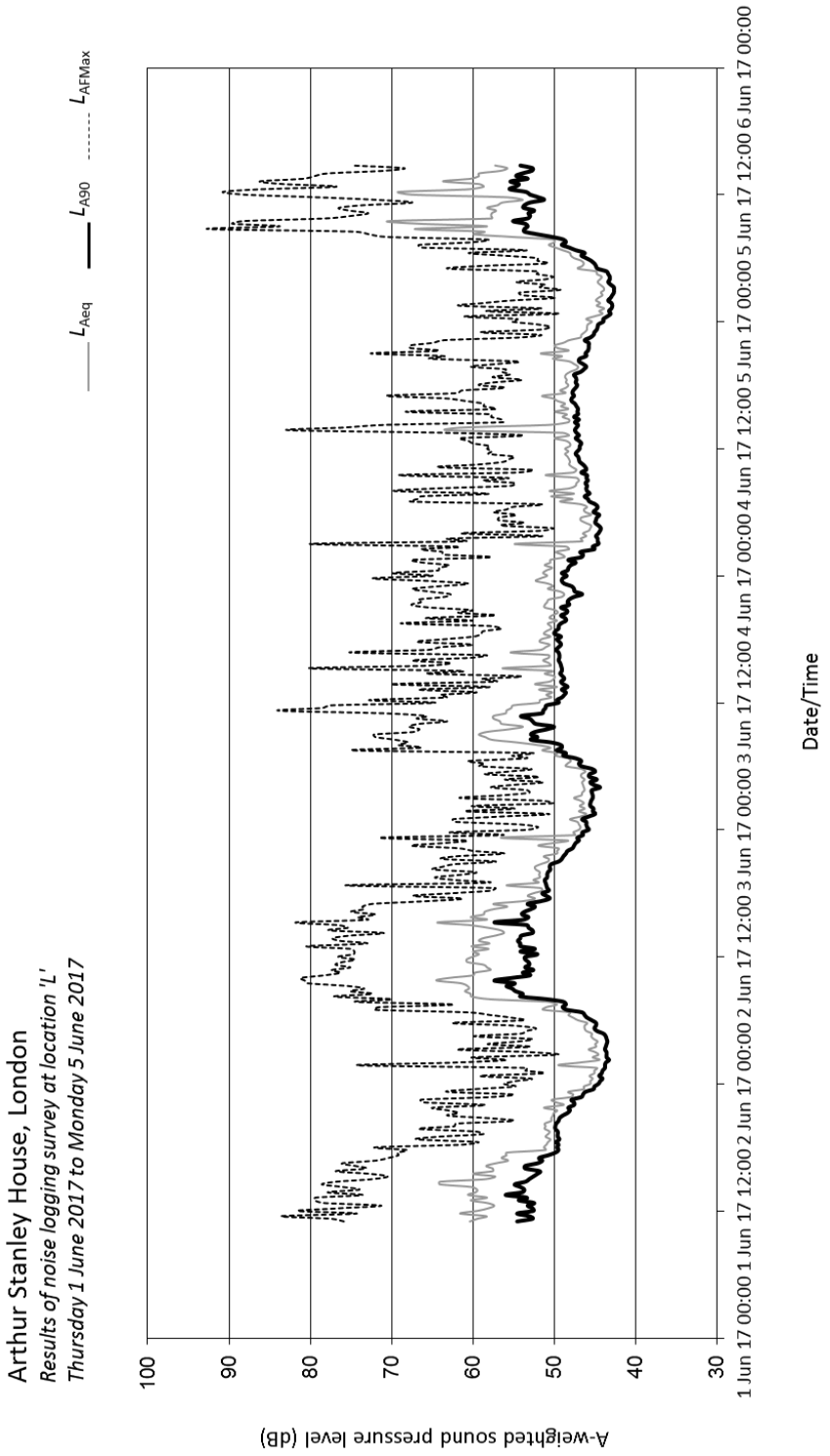
During the attended measurements carried out on Thursday 1 June 2017, Monday 6 June 2017, and Friday 9 June 2017, the weather was generally clear and dry and no rain occurred. Wind speeds were low.

During the unattended noise measurements between Thursday 1 June 2017 and Monday 6 June 2017 weather reports for the area indicated that temperatures varied between 10°C at night and 24°C during the day, and wind speeds were low.

These weather conditions are considered suitable for obtaining representative measurements.

Appendix B

Results of unattended measurements at location ‘L’


Arthur Stanley House, London
Results of noise logging survey at location 'L'
Thursday 1 June 2017 to Monday 5 June 2017
L_{Aeq}
L_{A90}
L_{AFMax}
A-weighted sound pressure level (dB)
100
90
80
70
60
50
40
30
1 Jun 17 00:00
1 Jun 17 12:00
2 Jun 17 00:00
2 Jun 17 12:00
3 Jun 17 00:00
3 Jun 17 12:00
4 Jun 17 00:00
4 Jun 17 12:00
5 Jun 17 00:00
5 Jun 17 12:00
6 Jun 17 00:00
Date/Time