WeWork

125 Shaftesbury Avenue

Noise Assessment

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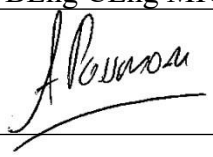
		Signature			
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Contents

Appendices

1 Introduction

Arup has been appointed to provide a fixed plant noise assessment for 125 Shaftesbury Avenue in support of the planning application. It is proposed that the existing plant on the building will be replaced, which is the focus of this assessment.

An environmental background noise survey has been undertaken to establish existing noise levels around the site. This report summarises the results of the noise survey, discusses noise limits for the proposed plant and compares predicted noise levels with the noise limits.

2 Site Location

125 Shaftesbury Avenue is located at the intersection of Charing Cross Road and Shaftesbury Avenue, London. The replacement plant will be located in an existing plantroom on the 10th floor of the building. In addition to this, new plant is proposed on the 7th floor roof terraces, found on the west and south eastern corners of the building. Figure 1 shows the location of the site marked in red, and the proposed plant locations.

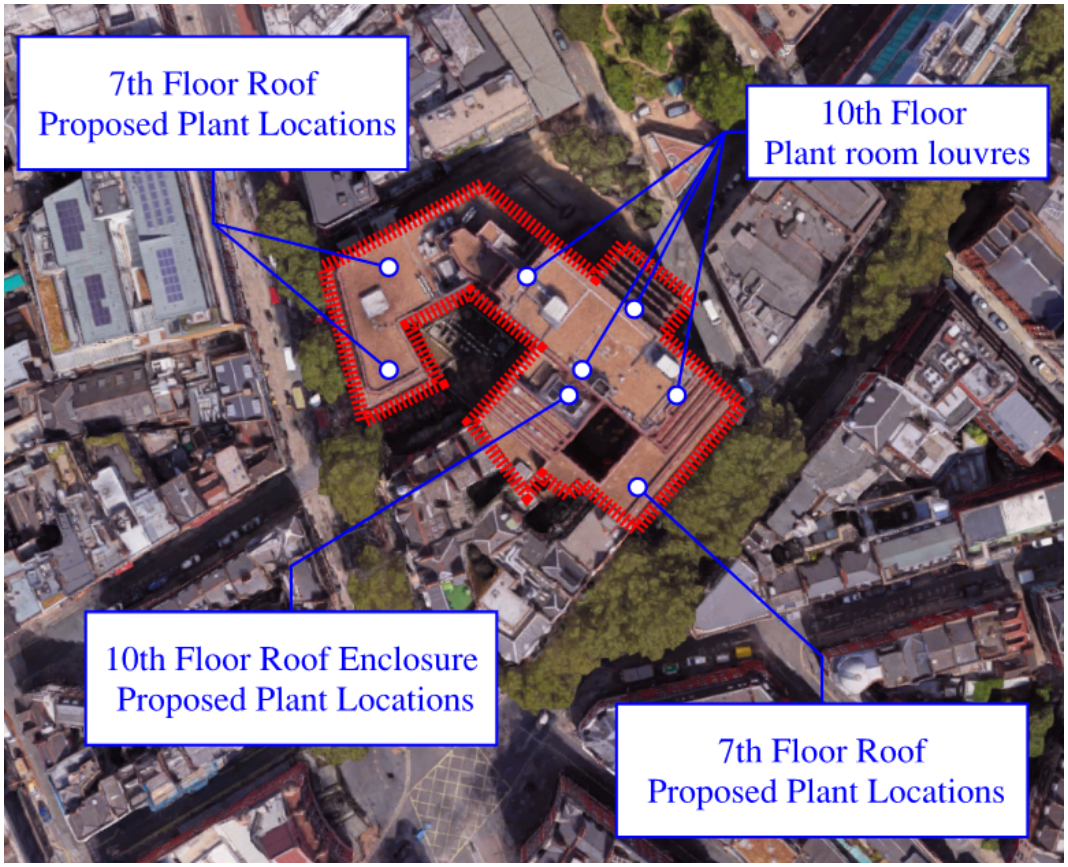


Figure 1: Site plan

3 Noise Policy

3.1 National Planning Policy Framework

The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these are expected to be applied. With regard to noise, Section 11 of 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.*

For the definition of adverse impacts, the NPPF references the Noise Policy Statement for England.

3.2 Noise Policy Statement for England

The Noise Policy Statement for England (NPSE) sets out the long term vision of Government noise policy, which is to promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

The NPSE has the following aims:

> *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*

The NPSE describes the following concepts:

LOAEL – Lowest Observed Adverse Effect Level: this is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level: this is the level above which significant adverse effects on health and quality of life can occur.

Therefore the aims of the NPSE are that noise levels above the SOAEL should be avoided and that noise levels between the LOAEL and the SOAEL should be mitigated and reduced using all reasonable steps while also taking into account the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur.

3.3 Camden Local Plan

The London Borough of Camden's noise policy states that the thresholds for noise and vibration impact are evaluated in terms of effect levels (i.e. LOAEL and SOAEL) in line with the NPPF and NPSE.

"Appendix 3: Noise Thresholds" in the Camden Local Plan states that values for the LOAEL and SOAEL for industrial and commercial noise sources should be determined using relevant standards or guidance documents. The standard referenced in the Local Plan is British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142). The local plan states that a 'Rating Level' of 10dB below background should be considered as the design criteria.

Appendix 3 in the Local Plan sets out noise levels applicable to proposed industrial and commercial developments in terms of LOAEL and SOAEL as reproduced in Table 1.

Noise sensitive receptor	Assessment Location	Design Period	LOAEL	LOAEL to SOAEL	SOAEL
Dwellings	Outdoor amenity areas	Day	'Rating Level' 10dB below background	'Rating Level' 9dB below and 5dB above background	'Rating Level' greater than 5dB above background
	Outside bedroom window	Night	'Rating Level' 10dB below background and no events exceeding 57dBL_{Amax}	'Rating Level' 9dB below and 5dB above background or noise events between 57dB and 88dBL_{Amax}	'Rating Level' greater than 5dB above background and/or events exceeding 88dBL_{Amax}

Table 1: Camden Local Plan noise level limits for proposed developments

The daytime and night time periods correspond to 07:00 – 23:00 and 23:00 – 07:00 respectively.

The Local Plan states that noise levels below the LOAEL are considered to be at an acceptable level, noise levels between LOAEL and SOAEL are observed to have an adverse effect, but may be considered acceptable when assessed in the context of other merits of the development, and noise levels above the SOAEL are observed to have a significant adverse effect.

4 Noise Sensitive Receptors

There are a number of noise sensitive receptors around the site. The closest noise sensitive receptors to the building are:

- Residential dwellings above shops on Shaftesbury Avenue, directly opposite 125 Shaftesbury Avenue – approximately 25m from the closest new plant
- Residential dwellings above shops on Charing Cross Road – approximately 35m from the closest new plant
- Residential dwellings on Phoenix Street – approximately 20m from the closest new plant

5 Environmental Noise Survey

An environmental noise survey has been undertaken to establish the existing prevailing background noise levels around the site, using a series of unattended and attended noise monitors.

It should be noted that the survey was conducted after the existing plant was decommissioned and therefore measured background noise levels are likely to be lower than before the existing plant was switched off.

5.1 Dates, Times and Personnel

The unattended noise monitors were installed by Harry Bartley and Chris Wong, of Arup Acoustics.

Continuous unattended measurements were carried out over a 6 day period, between approximately 16:00 on Friday 23rd February and 16:00 on Thursday 1st March 2018.

In addition, attended measurements were taken on Tuesday 27th February between 02:00 and 03:00 at pedestrian level.

5.2 Site Conditions

The weather during the measurements was cold but mostly dry, with acceptable wind speeds for the unattended survey, until Wednesday 28 February. On Wednesday 28 February and Thursday 1 March, the measurements were affected by snowy conditions. The lowest measured noise levels, which are used in this assessment, were measured during the dry period of the survey and are therefore considered representative.

5.3 Measurement Location

Noise monitors were installed at two locations of the development; the first on a first floor podium toward the rear and overlooking Phoenix Street, and the second on the Level 7 roof overlooking Charing Cross Road.

It was not possible to gain safe access to install a monitor on the Shaftesbury Avenue side of the building. Therefore, attended measurements were taken on the roadside, at three locations considered representative of nearby dwellings. These three locations were located on Charing Cross Road, Phoenix Street, and Shaftesbury Avenue. The purpose of these measurements was to establish the relative difference in noise levels between the Shaftesbury Avenue receptors and the Charing Cross Road receptors.

A site plan showing the attended and unattended measurement locations is shown in Figure 2. The unattended noise logger set-up at both locations is shown in Figures 3 and 4.

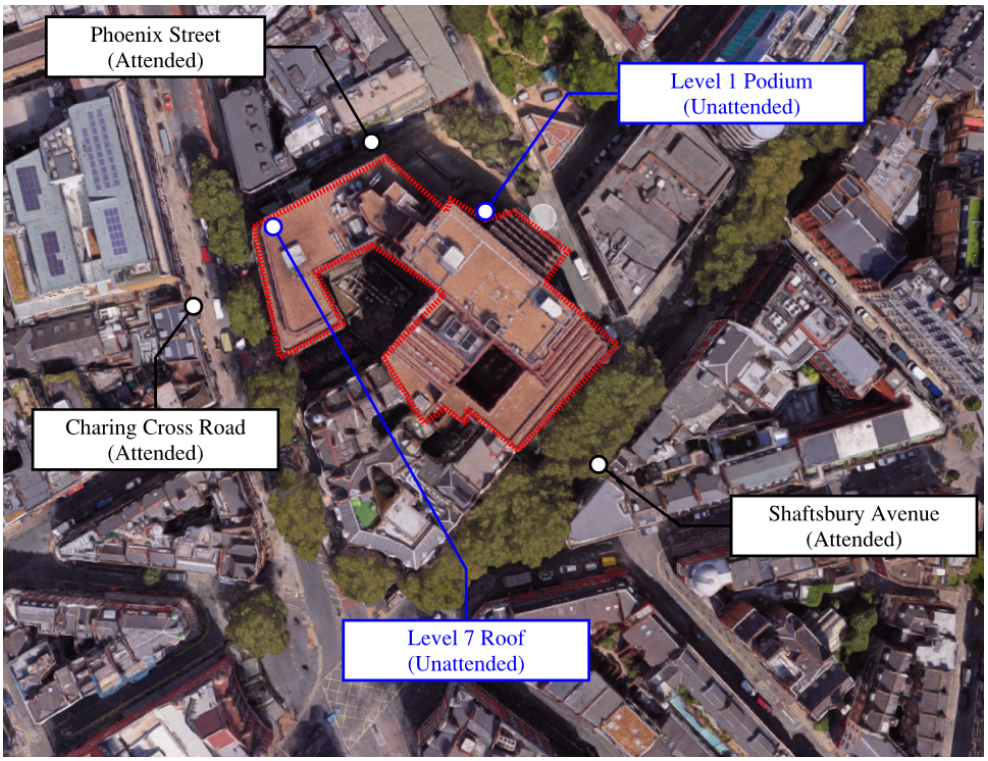


Figure 2: Site plan showing 125 Shaftesbury Avenue and measurement locations

Figure 3: Unattended noise logger on the 7th Floor Roof

Figure 4: Unattended noise logger on the 1st Floor Podium

During the periods in which Arup staff were at site, the noise levels at each location were dominated by road traffic and pedestrian noise on Shaftesbury Avenue and Charing Cross Road.

5.4 Equipment and Methodology

During the measurements, statistical noise levels were recorded, storing L_{Aeq}, L_{A90} and L_{Amax} indices. Octave band frequency spectra were also recorded.

All measurements during the survey were made over 5 minute periods.

Measurements were carried out using the equipment detailed in Tables 2 and 3. The sound level meters and microphones are Type 1 conforming to BS EN 61672-1: 2003. The sound level meters and microphones were calibrated before and after use, to confirm that there was no significant drift in meter response at the calibrator frequency and level. This verification indicated that there was no more than a 0.1 dB variation between checks. The meters are annually calibrated and this calibration is traceable to international standards. All measurements were made with A-weighting and fast (0.125 s) time constant.

Manufacturer	Type Number	Serial Number	Instrumentation
Bruel and Kjær	2250	3008760	Sound Level Meter
Bruel and Kjær	4189	3004620	Microphone
Bruel and Kjær	4231	1820981	Calibrator

Table 2: Attended Noise survey measurement equipment

Manufacturer	Type Number	Serial Number	Instrumentation
RION	NL-25	10479	Pre Amplifier
RION	NL-25	21615	Pre Amplifier
RION	NC-74	35015346	Calibrator
RION	NC-74	34336008	Calibrator
RION	NL-52	00120480	Sound Level Meter
RION	NL-52	00231671	Sound Level Meter
RION	NC-59	03152	Microphone
RION	NC-59	04716	Microphone

Table 3: Unattended Noise survey measurement equipment

5.5 Results

A summary of the results is presented in Table 4 for the unattended survey and Table 5 for the attended survey, in terms of the $L_{Aeq,5min}$, $L_{A90,5min}$ and $L_{Amax,F}$ noise parameters. (A full time history of the unattended measurements is presented in Appendix B, and the full attended measurements in Appendix C).

Time Period	Location	Measured Noise Level, dB		
		$L_{Aeq,5mins}$	$L_{A90,5mins}$	$L_{Amax,F}$
Daytime (07:00–23:00)	Level 7 Roof (Charing Cross Rd)	53 – 73	51 - 61	59 – 93
Night-time (23:00–07:00)	Level 7 Roof (Charing Cross Rd)	50 – 69	47 – 60	56 – 88
Daytime (07:00–23:00)	Level 1 Podium (Phoenix Street)	49 – 72	46 – 59	56 – 95
Night-time (23:00–07:00)	Level 1 Podium (Phoenix Street)	44 – 68	42 – 58	50 – 87

Table 4: Summary of results from unattended noise measurements

Time Period	Location	Measured Noise Level, dB		
		$L_{Aeq,5mins}$	$L_{A90,5mins}$	$L_{Amax,F}$
0200 – 0300	Charing Cross Road	66 – 71	53 – 58	77 – 87
	Shaftesbury Avenue	68 – 71	51 – 59	79 – 84
	Phoenix Street	57 – 60	50 – 53	70 - 79

Table 5: Summary of results from attended noise measurements

The results of the survey indicate that the lowest daytime background noise level was 51dB$L_{A90,5mins}$ on the rooftop, and 46dB$L_{A90,5mins}$ on the Level 1 podium. Whilst during the night, the lowest levels were 47dB$L_{A90,5mins}$ and 42dB$L_{A90,5mins}$. These are considered to be representative of the conditions that prevail at Charing Cross Road and Phoenix Street.

Using the survey results as a basis, the lowest background noise levels representative of Shaftesbury Avenue have been adopted as 49dB$L_{A90,5mins}$ for the daytime and 45dB$L_{A90,5mins}$ for night, which has been assessed from the 2dB difference between the observed noise levels on Shaftesbury Avenue and Charing Cross Road during the attended survey.

6 Noise Limits

The limits for noise egress from fixed plant have been determined with reference to the lowest measured L_{A90} night level from the noise measurements. This is representative of the nearest residential property. Table 6 shows the LOAEL and SOAEL criteria considered for the proposed plant.

Noise Sensitive Receptor	LOAEL (dBA)		SOAEL (dBA)	
	Day	Night	Day	Night
Charing Cross Road	41	37	>56	>52
Shaftesbury Avenue	39	35	>54	>50
Phoenix Street	36	32	>51	>47

Table 6: LOAEL and SOAEL noise criteria for the proposed plant

7 Noise from Proposed Plant

This section describes the proposed plant and the mitigation measures required to ensure that the noise criteria are achieved at each receptor. The noise sensitive receptors used in the assessment are stated in Section 4.

The replacement plant consists of AHU's, toilet extract fans, and outdoor VRF units. Noise level predictions have been based on manufacturer noise data.

For the AHU's and fans, noise levels for the individual units have been provided by the manufacturer, with octave band sound power data used for the noise predictions.

For the VRF units, noise levels provided by the manufacturer have been given as an overall sound power level at the design load, and spectral data at full load. To analyse the spectral noise levels, it has been assumed that the spectral shape at full load is the same at the design load.

7.1 Noise Sources

7.1.1 10th Floor Plant Room

The plant room is located on the 10th Floor, with proposals showing that existing plant inside the room will be replaced with three AHU's, and a toilet extract fan.

The plant items have intake and exhaust paths terminating at louvres on the 10th floor. The largest louvre faces to the north east, and three smaller louvres are positioned on the other three faces of the plant room. These louvre locations are shown in Figure 1.

7.1.2 10th Floor Plant Enclosure

On the 10th floor adjacent to the plant room, it is proposed that outdoor LG VRF units will be positioned on the rooftop. The selection consists of 15 LG units that have a total sound power level of 82dB(A).

7.1.3 7th Floor Roof Terrace – Charing Cross Road

On the 7th Floor roof, the replacement plant consists of an AHU, twin fan toilet extract and LG VRF units.

The AHU and VRF unit noise sources are approximately 35m from the nearest noise sensitive receptor on Charing Cross Road. The toilet extract fan is closest to Phoenix Street, at an approximate distance of 20m.

7.1.4 7th Floor Roof Terrace – Shaftesbury Avenue

On the Shaftesbury Avenue facing terrace, VRF units are proposed that are approximately 25m away from the nearest receptor on Shaftesbury Avenue.

7.1.5 Summary of Plant

The following table provides a summary of the proposed plant:

Plant Item	Location	Number	Approximate Distance to nearest receptor	Sound Power Level per unit, dB(A)
AHU.01 Intake	10th Floor Plant Room	1	35	88
AHU.01 Exhaust	10th Floor Plant Room	1	45	93
AHU.02 Intake	10th Floor Plant Room	1	30	88
AHU.02 Exhaust	10th Floor Plant Room	1	60	93
AHU.03 Intake	10th Floor Plant Room	1	30	88
AHU.03 Exhaust	10th Floor Plant Room	1	45	93
Toilet Extract Fan	10th Floor Plant Room	1	45	77
VRF LG ARUM280LTE5	10th Floor Plant Enclosure	15	50	70
VRF LG ARUM280LTE5	7th Floor Roof – Shaftsbury Av.	12	25	70

Plant Item	Location	Number	Approximate Distance to nearest receptor	Sound Power Level per unit, dB(A)
AHU.04 Intake	7th Floor Roof – Charing Cross Rd.	1	20	86
AHU.04 Exhaust	7th Floor Roof – Charing Cross Rd.	1	20	85
AHU Casing Radiated	7th Floor Roof – Charing Cross Rd.	1	20	56
Toilet Fan Exhaust	7th Floor Roof – Charing Cross Rd.	1	20	80
Toilet Fan Casing Radiated	7th Floor Roof – Charing Cross Rd.	1	20	67
VRF LG ARUM280LTE5	7th Floor Roof – Charing Cross Rd	14	35	70
VRF LG ARUM140LTE5	7th Floor Roof – Charing Cross Rd.	3	35	70
VRF LG ARUM220LTE5	7th Floor Roof – Charing Cross Rd.	1	35	70

Table 7: Summary of proposed plant

7.2 Mitigation Measures

7.2.1 10th Floor Plant Room

The three AHU's within the plant room all include a 1.5m long attenuator on both the intake and extract sides to reduce noise levels to the environment.

7.2.2 10th Floor Plant Enclosure

The outdoor VRF units on the 10th floor will not need to include any additional mitigation due to the existing building walls that surround the outdoor plant enclosure providing sufficient mitigation.

7.2.3 7th Floor Roof Terrace – Charing Cross Road

The proposed AHU located on the 7th floor roof will include 1.5m long attenuators to both the intake and extract sides, which will reduce the noise levels towards the Charing Cross Road receptor.

The proposed toilet fan exhaust will face the Phoenix Street receptor. In order to reduce noise levels to this receptor, a 900mm attenuator will be included.

The VRF units on this roof terrace do not require any further mitigation.

7.2.4 7th Floor Roof Terrace – Shaftesbury Avenue

On this terrace, the VRF units are at a distance of 25m away from the nearest receptor on Shaftesbury Avenue. Due to the existing parapet on the roof edge, noise levels from the VRF units are mitigated.

7.3 Noise Predictions

Noise predictions have been undertaken for each noise sensitive receptor, using the total sound power levels from all proposed plant. Table 8 shows the predicted free-field noise level at the building compared against the LOAEL and SOAEL criteria.

Noise Sensitive Receptor	Predicted Level (dBA)	LOAEL (dBA)		SOAEL (dBA)	
		Day	Night	Day	Night
Charing Cross Road	34	41	37	>56	>52
Shaftesbury Avenue	33	39	35	>54	>50
Phoenix Street	32	36	32	>51	>47

Table 8: Predicted noise levels compared to LOAEL and SOAEL criteria

The octave band noise levels have been assessed and there is no indication of any tonal characteristics, therefore no additional penalty has been applied to the rating predicted level.

As shown in Table 8, the noise predictions indicate that noise levels from the proposed plant will be below the lowest daytime and night-time LOAEL at all locations.

8 Summary

An assessment has been undertaken of noise from the proposed replacement plant at 125 Shaftesbury Avenue.

London Borough of Camden has indicated that noise levels from plant should be compared to the LOAEL and SOAEL levels based on the lowest background L_{A90} noise levels.

An environmental noise survey has been taken to determine the existing background noise levels and define the LOAEL and SOAEL criteria representative of the nearest noise sensitive receptors,

Predictions of noise from the replacement plant have been made at each receptor. These indicate that the noise levels from the day and night-time running plant will be below the LOAEL at each receptor. Therefore the proposed replacement plant will comply with the noise requirements set out by London Borough of Camden.

Appendix A

Glossary of Acoustic Terminology

A1 Glossary of Acoustic Terminology

Decibel (dB)

The ratio of sound pressures which we can hear is a ratio of 10^6:1 (one million:one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound pressure level' (L_p) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.

dB(A)

The unit used to define a weighted sound pressure level, which correlates well with the subjective response to sound. The 'A' weighting follows the frequency response of the human ear, which is less sensitive to low and very high frequencies than it is to those in the range 500Hz to 4kHz.

In some statistical descriptors the 'A' weighting forms part of a subscript, such as L_{A10}, L_{A90}, and L_{Aeq} for the 'A' weighted equivalent continuous noise level.

Equivalent continuous sound level

An index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.

Maximum noise level

The maximum noise level identified during a measurement period. Experimental data has shown that the human ear does not generally register the full loudness of transient sound events of less than 125ms duration and fast time weighting (F) has an exponential time constant of 125ms which reflects the ear's response. Slow time weighting (S) has an exponential time constant of 1s and is used to allow more accurate estimation of the average sound level on a visual display.

The maximum level measured with fast time weighting is denoted as $L_{Amax,\,F}$. The maximum level measured with slow time weighting is denoted $L_{Amax,\,S}$.

Sound power level

The sound power level (L_w) of a source is a measure of the total acoustic power radiated by a source. The sound power level is an intrinsic characteristic of a source (analogous to its volume or mass), which is not affected by the environment within which the source is located.

Sound pressure level

The sound power emitted by a source results in pressure fluctuations in the air, which are heard as sound.

The sound pressure level (L_p) is ten times the logarithm of the ratio of the measured sound pressure (detected by a microphone) to the reference level of 2 x 10^{-5}Pa (the threshold of hearing).

Thus L_p (dB) = 10 log $(P1/P_{ref})^2$ where P_{ref}, the lowest pressure detectable by the ear, is 0.00002 pascals (ie $2x10^{-5}$ Pa).

The threshold of hearing is 0dB, while the threshold of pain is approximately 120dB. Normal speech is approximately 60dBL_A and a change of 3dB is only just detectable. A change of 10dB is subjectively twice, or half, as loud.

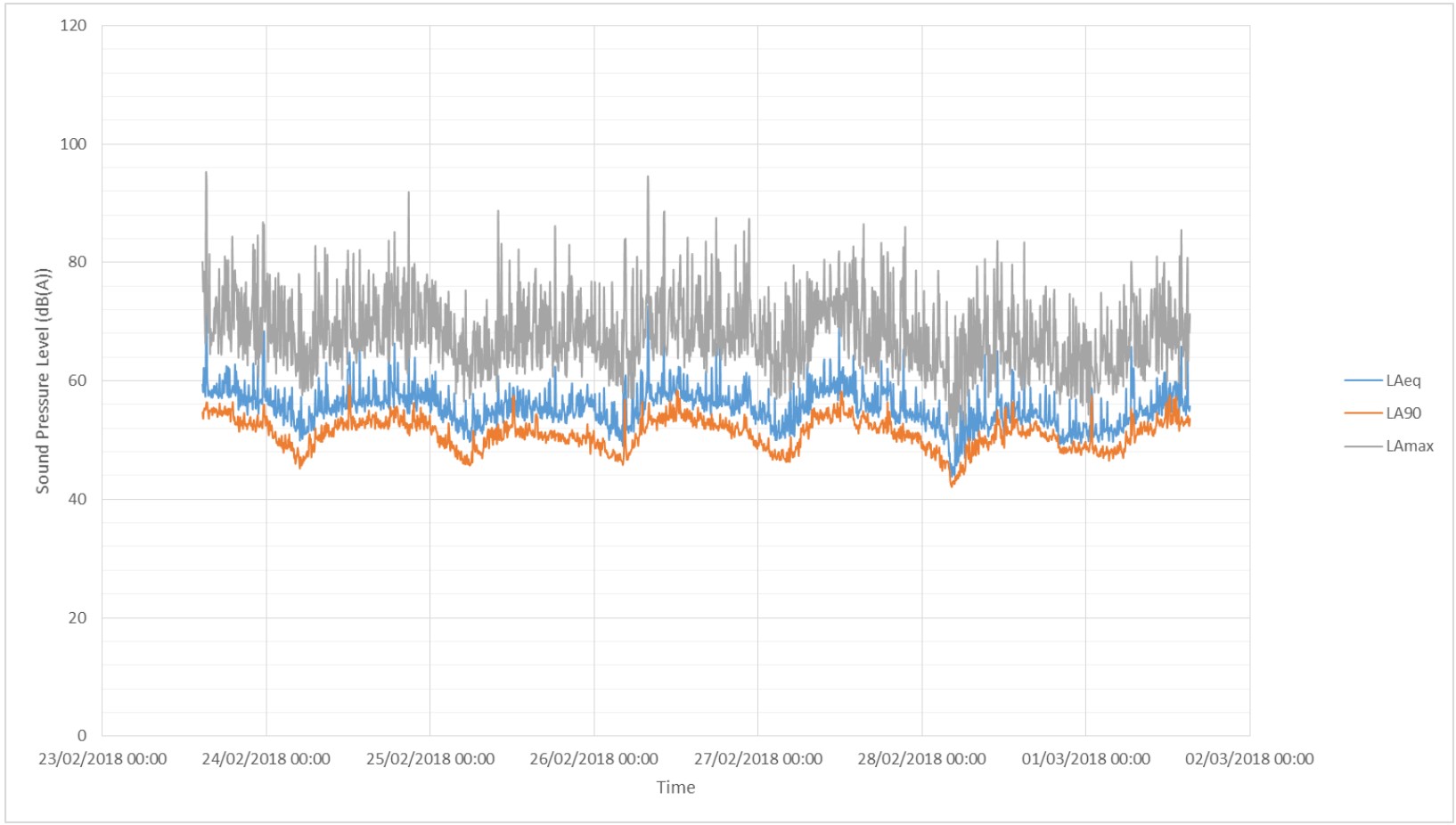
Statistical noise levels

For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L_{10}, the level exceeded for 10% of the time period under consideration, and can be used for the assessment of road traffic noise (note that L_{Aeq} is used in BS 8233 for assessing traffic noise). The L_{90}, the level exceeded for 90% of the time, has been adopted to represent the background noise level. The L_1, the level exceeded for 1% of the time, is representative of the maximum levels recorded during the sample period. A weighted statistical noise levels are denoted L_{A10}, dBL_{A90} etc. The reference time period (T) is normally included, e.g. dB$L_{A10,\ 5min}$ or dB$L_{A90,\ 8h}$

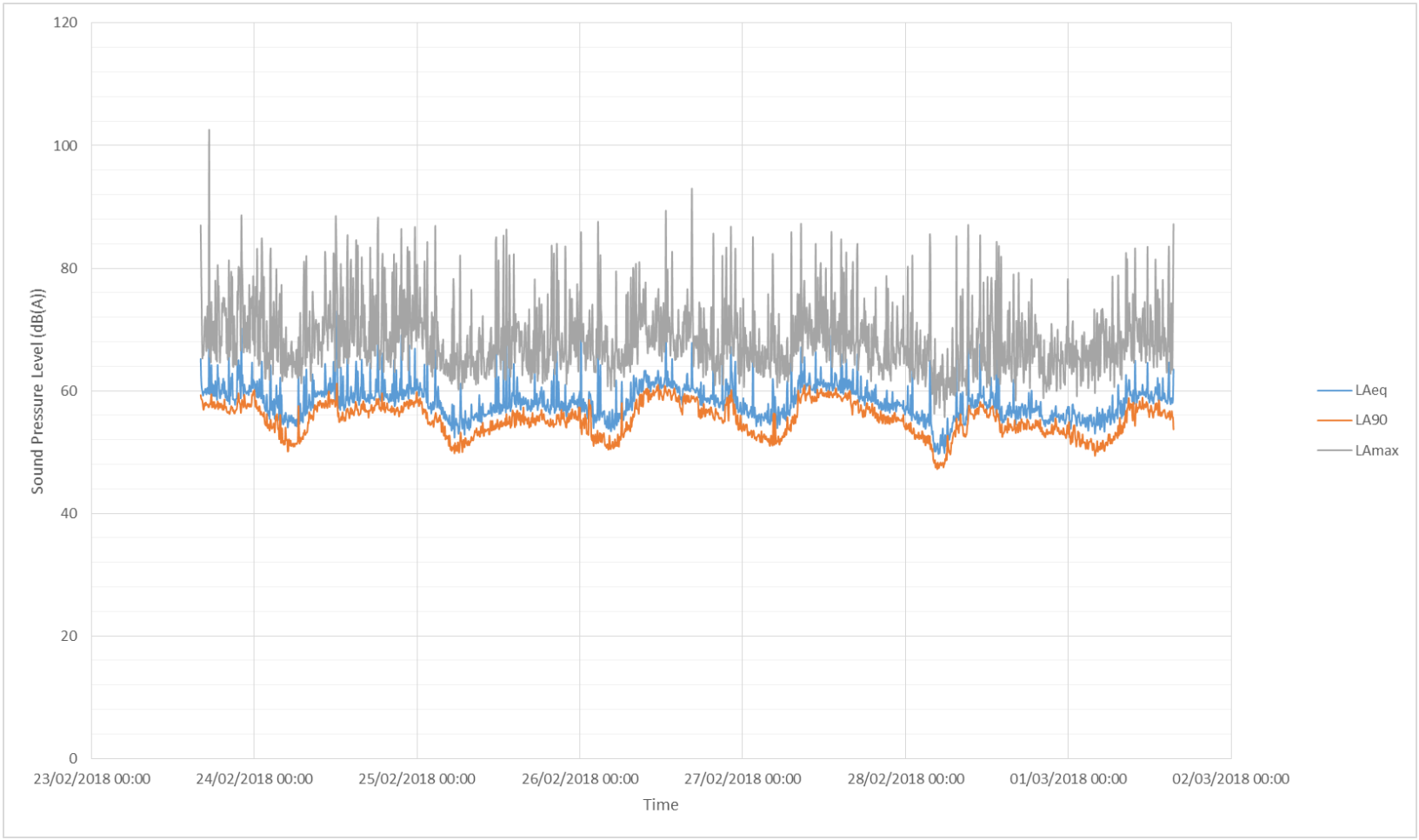
Appendix B

Unattended Noise Survey Time History

B1 Level 1 Podium Time History



B2 Level 7 Roof Time History



Appendix C

Attended Full Measurements

C1 Attended Measurement Results

Start Time	Noise Level dB(A)		
	L_{Aeq}	L_{A90}	L_{Amax}
Charing Cross Road			
02.22	68	57	83
02.27	71	58	87
03.00	67	53	79
03.05	66	56	77
Shaftesbury Avenue			
01.59	68	55	79
02.04	71	59	84
02.34	69	56	81
02.39	68	51	79
Phoenix Street			
02.10	60	53	76
02.15	57	51	70
02.46	59	50	74
02.51	60	52	79

Table 9: Attended Noise Survey Results