SANDY BROWN

*Consultants in Acoustics, Noise & Vibration*

**16038-R01-A**

**16 February 2016**

# 9-11 Grape Street

## *Environmental noise survey report*

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|---|---|---|---|---|
| A | 16 Feb 16 | | David Elliott | Daniel Stringer |

# Summary

Sandy Brown (SB) has been commissioned by Paragon Building Consultancy Ltd to provide acoustic advice in relation to the proposed development at 9-11 Grape Street, London.

An environmental noise survey has been carried out to determine the existing background sound levels in the area and setting appropriate plant noise limits in line with the requirements of the Camden Council.

The noise survey was performed between 16:00 on 3 February 2016 and 10:00 on 10 February 2016.

The representative background sound levels measured during the survey were $L_{A90,15min}$ 57 dB during the daytime and $L_{A90,15min}$ 50 dB at night.

Based on the requirements of the Camden Council and on the results of the noise survey, all 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 $L_{Aeq,15min}$ 52 dB during the daytime, and $L_{Aeq,15min}$ 45 dB during the night. These limits are cumulative, and apply with all plant operation under normal conditions. If plant items contain tonal or attention catching features, a penalty based on the type and impact of those features will be applied, and the limits will be more stringent than those set.

An initial facade sound insulation assessment has been carried out to determine the required acoustic performance of the facade, and provide guidance on the ventilation strategy.

The sound insulation performances for both the front and rear facades can be achieved using standard double glazing. Acoustically attenuated passive ventilation (eg trickle vents) or full mechanical ventilation could be employed as a ventilation strategy.

An assessment of potential tactile vibration and re-radiated noise from train movements along the London Underground central line close to the site was undertaken. The results of this assessment conclude that tactile vibration and re-radiated noise levels are below the limiting criteria set out be the relevant guidance and are unlikely to result in adverse comment.

# Contents

# 1 Introduction

Sandy Brown Associates LLP (SBA) has been commissioned by Paragon Building Consultancy Ltd to provide acoustic advice in relation to the proposed development at 9-11 Grape Street, London.

As part of this, an environmental noise survey is required, the purpose of which is to establish the existing background sound levels in the vicinity of nearby noise sensitive premises and to set appropriate limits for noise egress from building services plant.

This report presents the survey method, results of the environmental noise survey, and a discussion of acceptable limits for noise emission from building services plant.

# 2 Site description

## 2.1 The site and its surrounding

The site location in relation to its surroundings is shown in blue in Figure 1. It is located on Grape Street, a minor one-way street located in the Bloomsbury area of Camden. The street connects High Holborn to Shaftesbury Avenue, both of which are busy main roads with high traffic density. It has been proposed that the existing building, which previously comprised offices, studios and a gymnasium, is converted into Class B1 commercial offices.

The site lies to the south of the London Underground Central line, in between Holborn Station to the east and Tottenham Court Road to the west.

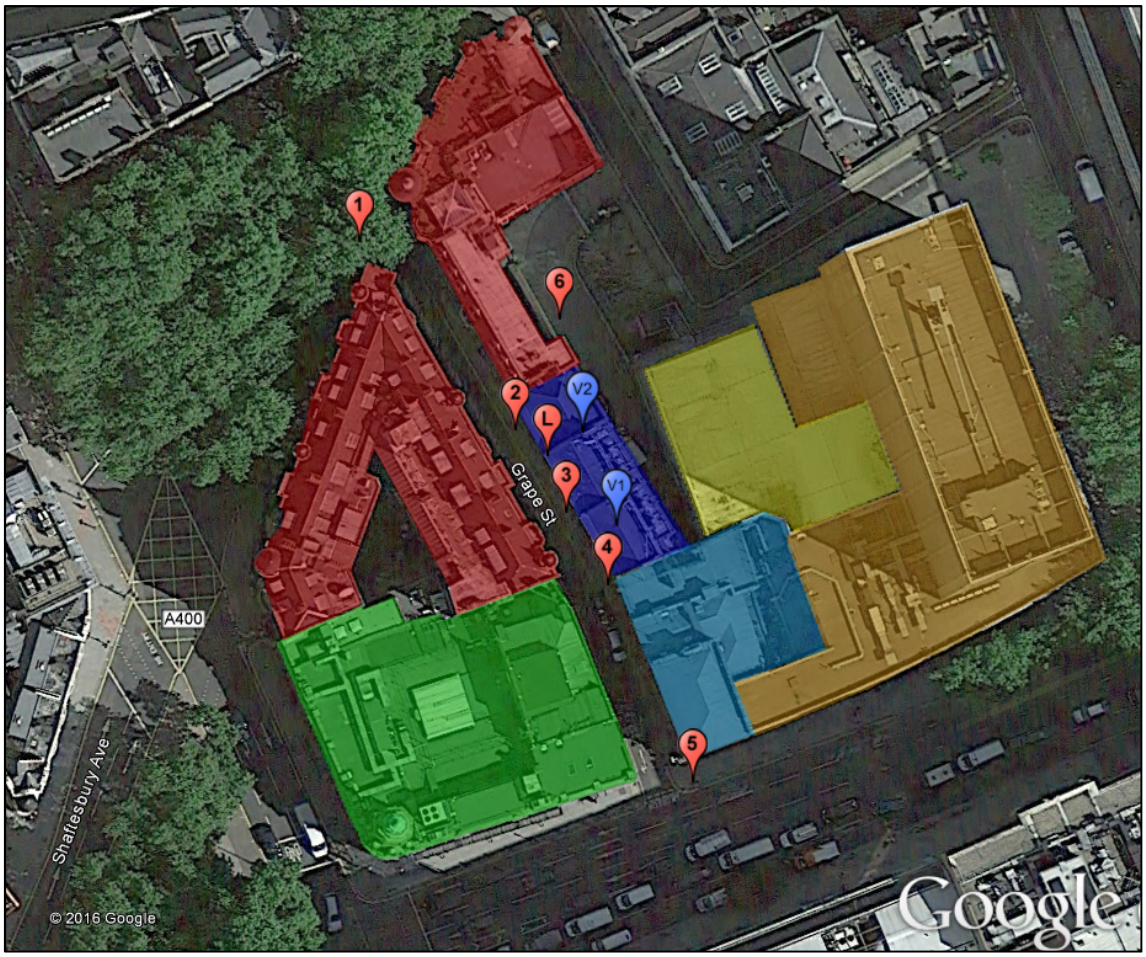



Figure 1 Site map (courtesy of Google Earth Pro) showing measurement locations, development in blue, adjacent residential buildings in red, theatre in green, hotel in orange, embassy in light blue and car park in yellow.

## 2.2 Adjacent premises

Located directly opposite and adjacent to the development are two residential buildings, which are shown in red in Figure 1. Also located on Grape Street is the Cuban Embassy, shown in light blue in Figure 1, and the rear of Shaftesbury Theatre, shown in green in Figure 1. Located to the east of the site is a multi-storey car park, shown in yellow in Figure 1, and a Travelodge hotel, shown in orange in Figure 1, which is around 15 storeys tall with guestrooms overlooking the site.

# 3 Method

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

## 3.1 Unattended measurements

Unattended noise monitoring was undertaken at the site over 7 days to determine the existing background sound levels in the vicinity of nearby noise sensitive premises.

The unattended measurements were performed over 15 minute periods between 16:00 on 3 February 2016 and 10:00 on 10 February 2016. The equipment was installed and collected by David Elliott.

The measurement position used during the survey is indicated in Figure 1, denoted by the letter 'L'. A photograph showing the measurement location is provided Figure 2. This location was chosen to be reasonably representative of the noise levels experienced by the nearest noise sensitive premises.

Figure 2 Photograph of noise logging equipment at location 'L'

## 3.2 Attended measurements

Attended sample measurements were performed by David Elliott at a number of locations around the site. These are indicated in Figure 1 as positions 1 to 6. The attended measurements were carried out on 9 February 2016, over 5 minute periods, with the purpose of determining the existing noise levels from road traffic, pedestrians and other significant noise sources in the area.

In each case the microphone was mounted on a tripod approximately 1.5 m above the ground level and 1 m from any other reflective surface.

### 3.3 Vibration survey method

Vibration measurements were performed at 2 locations around the site in order to determine the maximum vibration levels from the passage of trains on the railway tracks adjacent to the site. The vibration measurement locations are indicated in Figure 1as positions V1 and V2. A total of 20 individual train events were measured over the two locations.

For the vibration measurements, a tri-axial accelerometer was set up to measure both vibration dose values (VDV) and one for 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.

These measurements were performed on 3 February 2016.

The vibration measurements performed are considered to be reasonably representative of the maximum vibration levels at basement level.

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

The VDV measurements were conducted in three axes as follows:

- X axis - Horizontal vibration approximately perpendicular to the railway tracks;
- Y axis - Horizontal vibration approximately parallel to the railway tracks;
- Z axis - Vertical vibration.

The RMS acceleration measurements were performed in the vertical axis only.

## 4 Measurement results

### 4.1 Observations

The dominant noise sources observed at the site during the survey consisted of heavy traffic on High Holborn and Shaftesbury Avenue and pedestrians and light traffic passing down Grape Street. It was also noted that loud construction works were taking place on the rear facade of Shaftesbury Theatre, with intermittent activities such as drilling and welding taking place.

Less significant noise sources included nearby intermittent construction works in the surrounding area and pedestrians on High Holborn and Shaftesbury Avenue.

### 4.2 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. Measurements were taken at around 1 m from the building facade.

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) |
|---|---|---|
| Wed 3 Feb 2016 | n/a | 59 |
| Thurs 4 Feb 2016 | 68 | 60 |
| Fri 5 Feb 2016 | 65 | 60 |
| Sat 7 Feb 2016 | 64 | 61 |
| Sun 8 Feb 2016 | 61 | 60 |
| Mon 9Feb 2016 | 66 | 60 |
| Tues 10 Feb 2016 | 64 | 59 |
| Average | 65 | 60 |

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.

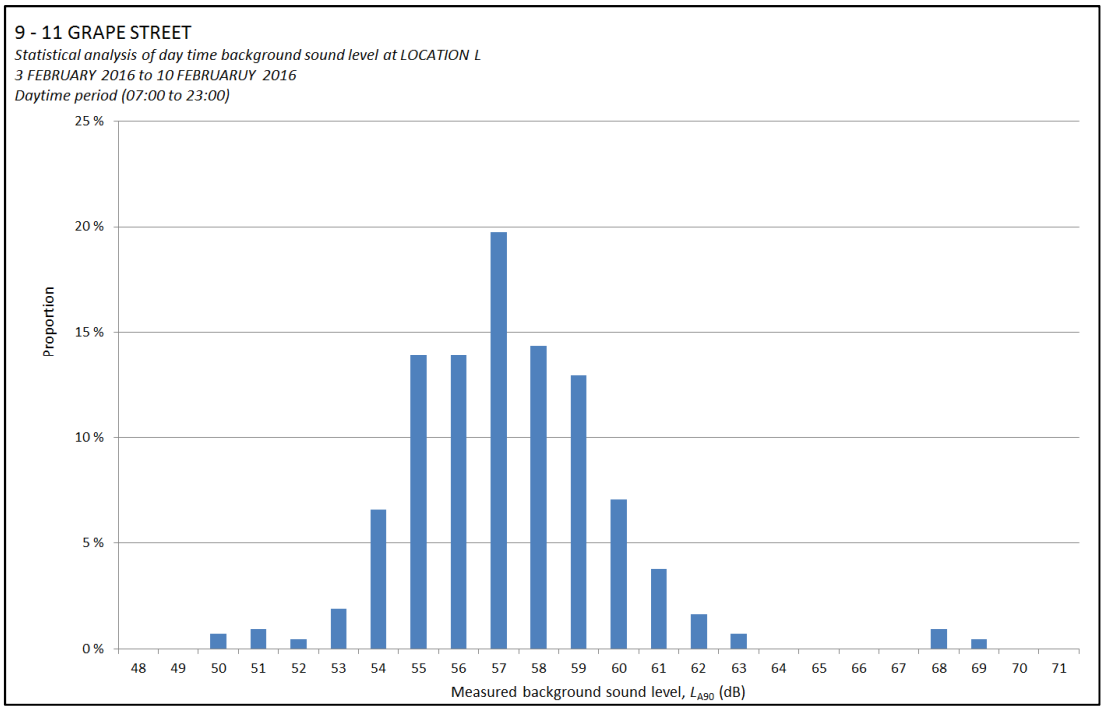



Figure 3 Bar graph showing statistical analysis of background noise levels during the day (07:00 – 23:00)

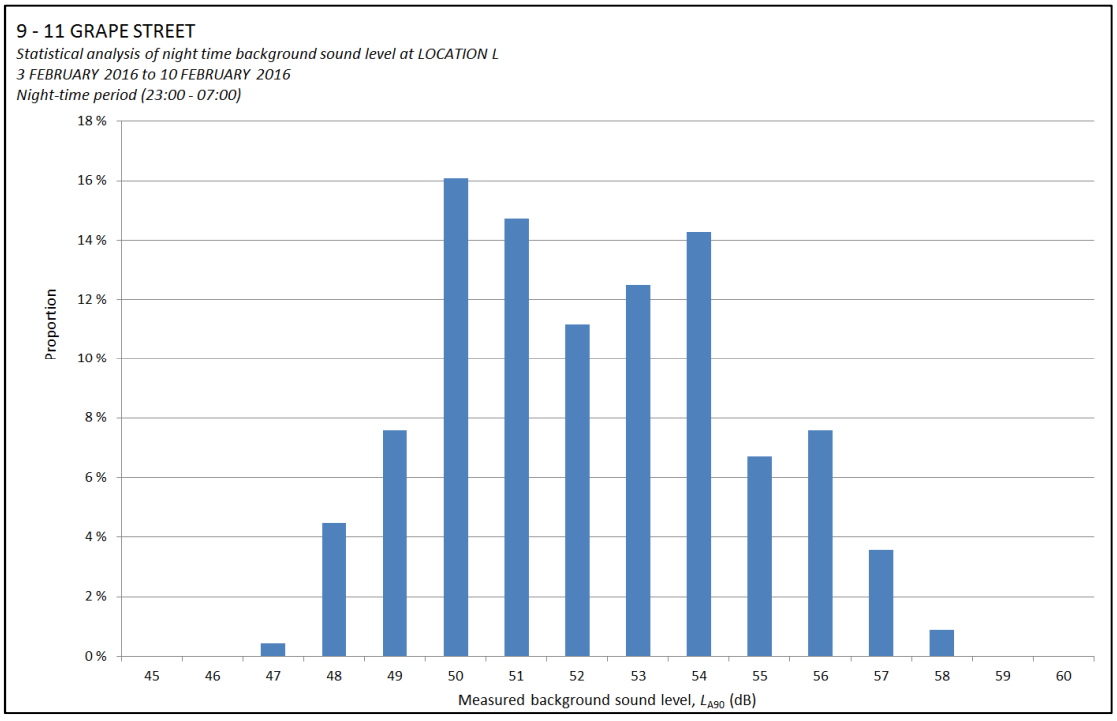



Figure 4 Bar graph showing statistical analysis of background noise levels at night (23:00 – 07:00)

From this analysis, the representative background sound levels measured during the survey were $L_{A90,15min}$ 57 dB during the daytime and $L_{A90,15min}$ 50 dB at night.

## 4.3 Attended measurement results

The sound pressure levels recorded during the attended measurements are summarised in Table 2. The dominant noise sources noted during the measurements are also described in Table 2. All the attended measurements were performed over 5 minute periods.

Table 2 Sound pressure levels from attended measurements

| Position | Start time | Sound pressure levels (dB) | | | Noise sources |
|---|---|---|---|---|---|
| | | $L_{Aeq,5min}$ | $L_{AFmax,5min}$ | $L_{A90,5min}$ | |
| 1[2] | 09:47 | 65 | 76 | 61 | Moderate traffic, pedestrian |
| 1[2] | 09:53 | 69 | 87 | 62 | Moderate traffic, pedestrian |
| 2[1] | 09:58 | 63 | 73 | 58 | Traffic from surrounding streets, pedestrian, construction |
| 3[1] | 10:22 | 63 | 79 | 58 | Traffic from surrounding streets, pedestrian, construction, single car passes |
| 4[1] | 10:06 | 63 | 79 | 59 | Traffic from surrounding streets, pedestrian, construction, single car passes |
| 5[1] | 09:36 | 70 | 81 | 64 | Heavy traffic, pedestrian, construction |
| 5[1] | 09:41 | 72 | 90 | 67 | Heavy traffic, pedestrian, construction |
| 6[1] | 10:15 | 57 | 65 | 54 | Plant, single car passes |

1 – Measurements conducted at around 1 m from facade
2 – Measurements conducted in free field

## 4.4 Vibration measurement results

### 4.4.1 *Tactile vibration measurements*

The following tables present the vibration dose values measured at locations V1 and V2 respectively. These measurements were performed on Wednesday 3 February 2016 and are considered representative of the vibration levels to be experienced by the proposed development during a single train pass. The maximum vibration dose values measured are highlighted in red.

Table 3 Vibration dose values measured at location V1

| Start time | Duration (mm:ss) | Number of events | VDV ($m/s^{1.75}$) | | |
|---|---|---|---|---|---|
| | | | X | Y | Z |
| 16:07 | 00:19 | 1 | 0.000 | 0.000 | 0.002 |
| 16:09 | 00:21 | 1 | 0.001 | 0.001 | 0.002 |
| 16:11 | 00:29 | 1 | 0.001 | 0.001 | 0.002 |
| 16:13 | 00:18 | 1 | 0.001 | 0.000 | 0.002 |
| 16:14 | 00:16 | 1 | 0.001 | 0.000 | 0.002 |
| 16:15 | 00:20 | 1 | 0.001 | 0.000 | 0.002 |
| 16:16 | 00:17 | 1 | 0.000 | 0.000 | 0.001 |

Table 4 Vibration dose values measured at location V2

| Start time | Duration (mm:ss) | Number of events | VDV ($m/s^{1.75}$) | | |
|---|---|---|---|---|---|
| | | | X | Y | Z |
| 16:23 | 00:28 | 1 | 0.001 | 0.000 | 0.003 |
| 16:24 | 00:24 | 1 | 0.001 | 0.001 | 0.002 |
| 16:26 | 00:29 | 1 | 0.001 | 0.000 | 0.002 |
| 16:28 | 00:23 | 1 | 0.001 | 0.000 | 0.002 |
| 16:30 | 00:21 | 1 | 0.001 | 0.000 | 0.002 |
| 16:31 | 00:26 | 1 | 0.000 | 0.000 | 0.002 |
| 16:32 | 00:29 | 1 | 0.001 | 0.000 | 0.003 |
| 16:33 | 00:24 | 1 | 0.001 | 0.000 | 0.002 |
| 16:35 | 00:29 | 1 | 0.001 | 0.000 | 0.002 |
| 16:36 | 00:26 | 1 | 0.000 | 0.000 | 0.001 |
| 16:36 | 00:18 | 1 | 0.001 | 0.000 | 0.001 |
| 16:38 | 00:19 | 1 | 0.000 | 0.000 | 0.002 |
| 16:41 | 00:22 | 1 | 0.000 | 0.000 | 0.001 |

### 4.4.2 *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, based on the vibration measurements at locations V1 and V2 are presented in the following tables in terms of $L_{ASmax}$ as referred to in BS 6472.

Table 5 Predicted re-radiated noise levels from vibration measurements at basement location V1

| Start time | Train event duration (min) | $L_{ASmax}$ (dB) |
|---|---|---|
| 16:07 | 00:19 | 22 |
| 16:09 | 00:21 | 21 |
| 16:11 | 00:29 | 22 |
| 16:13 | 00:18 | 19 |
| 16:14 | 00:16 | 19 |
| 16:15 | 00:20 | 23 |
| 16:16 | 00:17 | 22 |

Table 6 Predicted re-radiated noise levels from vibration measurements at basement location V2

| Start time | Train event duration (min) | $L_{ASmax}$ (dB) |
|---|---|---|
| 16:23 | 00:28 | 31 |
| 16:24 | 00:24 | 32 |
| 16:26 | 00:29 | 31 |
| 16:28 | 00:23 | 30 |
| 16:30 | 00:21 | 30 |
| 16:31 | 00:26 | 30 |
| 16:32 | 00:29 | 31 |
| 16:33 | 00:24 | 32 |
| 16:35 | 00:29 | 32 |
| 16:36 | 00:26 | 31 |
| 16:36 | 00:18 | 31 |
| 16:38 | 00:19 | 30 |
| 16:41 | 00:22 | 31 |

# 5 Assessment criteria

## 5.1 Building services – noise egress

### 5.1.1 *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.

### 5.1.2 *Local Authority criteria*

The requirements of Camden Borough Council are set out in Table 7 below.

Table 7 External plant noise limits for Camden Council Borough

| Noise description and location of measurement | Period | Time | Noise Level |
|---|---|---|---|
| Noise at 1 m external to a sensitive facade | Day, evening and night | 0000-2400 | 5 dB(A) $<L_{A90}$ |
| Noise that has a distinguishable discrete continuous note (whine, hiss, screech hum) at 1 m external to a sensitive facade. | Day, evening and night | 0000-2400 | 10 dB(A) $<L_{A90}$ |
| Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 m external to a sensitive facade | Day, evening and night | 0000-2400 | 10dB(A)$<L_{A90}$ |

On this basis, all external plant installed at the site must be designed such that the cumulative level at the nearest noise sensitive receiver is not less than 5 dB below the representative measured background noise level ($L_{A90,15min}$), unless it contains tones or impulsive sound.

## 5.2 Internal noise level – noise ingress

### 5.2.1 *Standard guidance – offices*

Guidance on acceptable internal noise levels in offices from external noise ingress is given in the BCO Guide to Specification (2014) and is presented in Table 8.

BCO presents internal noise criteria in terms of Noise Rating (NR). The approximate equivalent level in terms of dBA is also presented in brackets for direct comparison with other standards.

Table 8 Internal noise criteria from external noise ingress given in BCO Guide to Specification 2014

| Office space | External noise ingress criterion |
|---|---|
| Open plan office | NR40($L_{eq,T}$) [≈46 dBA] |
| Speculative offices | NR38($L_{eq,T}$) [≈44 dBA] |
| Cellular offices/meeting rooms | NR35($L_{eq,T}$) [≈41 dBA] |

### 5.2.2 *Local Authority requirements*

Camden council has no specific guidance for internal noise levels within commercial buildings. For this reason, the standard BCO guidance has been used as the assessment criteria in this report.

## 5.3 Tactile vibration criteria

### 5.3.1 *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.

The BS 6472-1: 2008 guidance for office buildings is reproduced in the table below.

Table 9 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 |
| Office buildings 16 hr day | 0.4 to 0.8 | 0.8 to 1.6 | 1.6 to 3.2 |

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.

### 5.3.2 *Local authority guidance*

The requirements of Camden Borough Council for tactile vibration within office developments are set out in Table 10.

Table 10 Camden Council tactile vibration assessment criteria

| Vibration description and location of measurement | Period | Time | Noise Level |
|---|---|---|---|
| Vibration inside offices | Day, evening and night | 0000-2400 | 0.4 VDV ms-1.75 |

## 5.4 Re-radiated noise criteria

### 5.4.1 *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 British Council for Offices (BCO) Guide to Specification 2014 states that vibration transfer from intermittent sources, such as underground trains, to internal areas should not lead to re-radiated noise levels in occupied cellular offices and meeting rooms of more than 45 dB $L_{Amax(fast)}$, or 50 dB $L_{Amax(fast)}$ for open plan offices.

# 6 Plant noise assessment – noise egress

## 6.1 Limits

Based on the above criteria and the measurement results, the cumulative noise level resulting from the operation of all new plant at 1 m from the worst affected windows of the nearest noise sensitive premises should not exceed the limits set out in Table 11.

Table 11 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) | 52 |
| Night-time (23:00-07:00) | 45 |

The limits set out in Table 11 do not include any attention catching features.

## 6.2 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.

# 7 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.

The following assessment is based on achieving the internal noise levels recommended in the BCO Guide to Specification (2014), which is detailed in Section 5.2.

## 7.1 External noise levels

The predicted worst-case daytime and night time external noise levels at the various facades of the proposed development are described in Table 12.

Table 12 External noise levels at front and back facades

| Facade | Predicted daytime external noise level (dB) |
|---|---|
| Front | 68 |
| Rear | 57 |

## 7.2 Facade sound insulation

To achieve the internal noise criteria in Section 5.2, the minimum facade sound insulation requirements have been determined based on the external noise levels at each facade as stated above. The minimum sound insulation performances for the different building facades are given in Table 13.

Table 13 Facade sound insulation performance requirements

| Facade | Overall sound insulation performance $R'_w+C_{tr}$ (dB)) |
|---|---|
| Front | 27 |
| Rear | 16 |

## 7.3 Guidance on facade construction, glazing, and ventilation strategy

The facade sound insulation performances for both facades can be achieved using standard double or triple glazing. Acoustically attenuated passive ventilation (eg trickle vents) or full mechanical ventilation could be employed as a ventilation strategy. The use of openable windows as the main ventilation strategy would result in the exceedance of the internal noise criteria specified in Section 5.2.

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.

# 8 Vibration assessment

## 8.1 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 both measurement locations V1 and V2, the highest vibration dose value was measured on the Z axis.

Published timetables indicate that approximately 30 trains pass by the site per hour in each direction during the busiest period of the day. This will result in approximately 960 trains passing on the tracks between 07:00 – 23:00. In anticipation of a 24 hour central line service, it has also been assumed that trains running at night will run at the same frequency as during the day, as a worst case scenario. This results in the prediction that approximately 480 trains will pass on the tracks between 23:00 – 07:00.

Based on the maximum vibration values from Table 3 and on the number of trains passing on the tracks between 07:00 – 23:00 and 23:00 – 07:00, the equivalent vibration dose values over a 16 hour day and an 8 hour night are given in the following table.

Table 14 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) |
| V1 | 0.002 | 0.01 | 0.01 |
| V2 | 0.003 | 0.02 | 0.01 |

By comparing the calculated day and night time vibration dose values above with the assessment table given in Section 5.3 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.

## 8.2 Re-radiated noise

During the ground-borne noise measurements, approximately 11 individual train events were observed. The highest predicted train noise level for all of these events was $L_{ASmax}$ 32 dB at basement level.

This is lower than the BCO guideline limits discussed in Section 5.4 and on this basis, ground-borne noise in the proposed residences is unlikely to result in adverse comment.

A number of studies have indicated that there is attenuation of ground-borne noise and vibration levels with height in a building. Guidelines published by the Association of Noise Consultants (ANC) in 2012 indicate that 2 dB of attenuation per floor should be allowed for the first five floors of a building.

With a maximum level of $L_{ASmax}$ 32 dB at basement level, it is expected that re-radiated noise from train events will be virtually inaudible in most parts of the building and will be well masked by any building services which are installed.

# 9 Conclusion

A noise survey has been carried out to determine the existing background sound levels in the vicinity of the site and surrounding noise sensitive premises. The representative background sound levels were $L_{A90,15min}$ 57 dB during the day, and $L_{A90,15min}$ 50 dB during the night.

On the basis of the requirements of the Local Authority, the relevant plant noise limits at the worst affected existing noise sensitive premises would be $L_{Aeq}$ 52 dB during the day, and $L_{Aeq}$ 45 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 5 dB penalty will be applied.

An initial facade sound insulation assessment has been carried out to determine the required acoustic performance of the facade, and provide guidance on the ventilation strategy.

The sound insulation performances for both the front and rear facades can be achieved using standard double glazing. Acoustically attenuated passive ventilation (eg trickle vents) or full mechanical ventilation could be employed as a ventilation strategy.

An assessment of potential tactile vibration and re-radiated noise from train movements along the London Underground central line close to the site was undertaken. The results of this assessment conclude that tactile vibration and re-radiated noise levels are below the limiting criteria set out be the relevant guidance and are unlikely to result in adverse comment.

# Appendix A – Survey details

## Equipment

A Rion NL-32 sound level meter was used to undertake the unattended measurements. The attended measurements were carried out using a Bruel & Kjaer 2260 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 |
|---|---|---|---|---|
| 2260C | | | | |
| Sound level meter | 2260/2553982 | Bruel & Kjaer | 22 May 17 | CDK1503819 |
| Microphone | 4189/2978316 | Bruel & Kjaer | 22 May 17 | CDK1503819 |
| Pre Amp | ZC0026/4584 | Bruel & Kjaer | 22 May 17 | CDK1503819 |
| Calibrator | 4231/2558390 | Bruel & Kjaer | 21 May 17 | CDK1503794 |
| NL-32C | | | | |
| Sound level meter | NL-32/00623762 | Rion | 13 Oct 17 | 1510549 |
| Microphone | UC-53A/319234 | Rion | 13 Oct 17 | 1510549 |
| Pre-amp | NH-21/76670 | Rion | 13 Oct 17 | 1510549 |
| Calibrator | NC-74/34536130 | Rion | 02 Oct 17 | 1510534 |

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.*

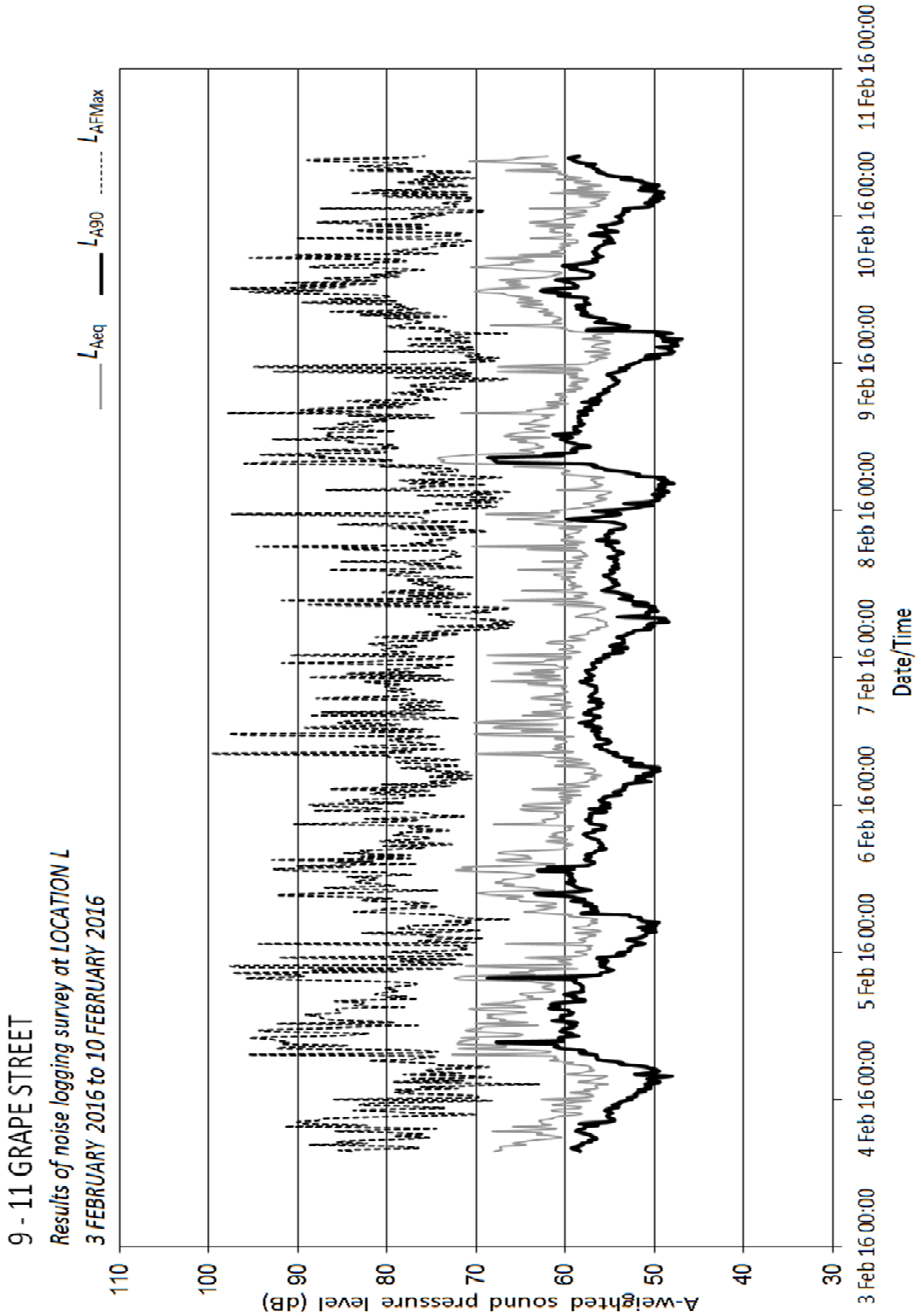
## Weather conditions

During the attended measurements carried out on 09 February 2016, the weather was clear and dry and no rain occurred. Wind speeds varied between approximately 1.8 m/s and 3.8 m/s.

During the unattended noise measurements between 3 February 2016 and 10 February 2016, weather reports for the area indicated that temperatures varied between 6°C at night and 10°C during the day. Wind speeds were high at times and varied on average between 2 m/s and 7 m/s. The measurement data on the days with higher wind speeds have been reviewed and it is not considered to have made an impact on the average measured background noise level.

In conclusion, these weather conditions are considered suitable for obtaining representative measurements.

# Appendix B – Results of unattended measurements at Location L


9 - 11 GRAPE STREET
Results of noise logging survey at LOCATION L
3 FEBRUARY 2016 to 10 FEBRUARY 2016
$L_{Aeq}$
$L_{A90}$
$L_{AFMax}$
A-weighted sound pressure level (dB)
110
100
90
80
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3 Feb 16 00:00
4 Feb 16 00:00
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Date/Time