REPORT

8-10 Southampton Row, Holborn

Noise and Vibration Assessment

Client: Ide Real Estate

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1 Introduction

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1.1 Background

This report presents the approach and findings of the assessment of potential effects on Noise and Vibration.

The report presents the methodology followed and provides a review of the baseline conditions within the site and surrounding area. The report then presents the results of the assessment of the effect of the Proposed Development on the baseline assessment scenarios in order to determine the anticipated magnitude and significance of effects. Mitigation measures are presented and discussed to minimise the effects of the Proposed Development during the operational phases to an acceptable level.

This assessment was undertaken by Royal HaskoningDHV.

1.2 Site Description and Surrounding Area

The Proposed Development is situated at 8-10 Southampton Row, Holborn, London. The site currently comprises a Grade II listed Edwardian Baroque building and is situated in central London. The site is bordered by the Southampton Row to the west, Fisher Street to the north, Catton Street to the south and office buildings immediately to the east.

1.3 Development Proposals

The Proposed Development is for a hotel and residential development comprising the refurbishment of the Grade II listed Edwardian Baroque building and new nine storey extension. The heritage building, Carlisle House, was constructed in 1905-06 as the Tollard Royal Hotel and Friendly Society Offices and is restored to its original use as a publicly accessible building within the Kingsway Conservation Area.

The hotel entrance and ground floor bar would be entered from Southampton Row, leading to the original central staircase which will provide the central circulation to the 85 hotel rooms both in the heritage building and new addition.

A gated residential entrance off Catton Street will lead to a double height lobby and access to nine flats which will be designed to current GLA Housing Design Guide standards. Seven of the flats will be south facing with inset balconies, and two would be North-East facing with views to Red Lion Square. The residential end of the building will also include a 57 m^2 rooftop terrace.

2 Legislative Framework and Planning Policy

2.1 National Legislation

2.1.1 Environmental Protection Act 1990[1]

Section 79 of the Act defines statutory nuisance with regard to noise and determines that local planning authorities have a duty to detect such nuisances in their area.

The Act also defines the concept of "Best Practicable Means" (BPM):

> *" 'practicable' means reasonably practicable having regard among other things to local conditions and circumstances, to the current state of technical knowledge and to the financial implications;*
>
> *the means to be employed include the design, installation, maintenance and manner and periods of operation of plant and machinery, and the design, construction and maintenance of buildings and structures;*
>
> *the test is to apply only so far as compatible with any duty imposed by law; and*
>
> *the test is to apply only so far as compatible with safety and safe working conditions, and with the exigencies of any emergency or unforeseeable circumstances."*

Section 80 of the Act provides local planning authorities with powers to serve an abatement notice requiring the abatement of a nuisance or requiring works to be executed to prevent their occurrence.

2.1.2 The Control of Pollution Act 1974[2]

Section 60 of the Act provides powers to Local Authority Officers to serve an abatement notice in respect of noise nuisance from construction works.

Section 61 provides a method by which a contractor can apply for 'prior consent' for construction activities before commencement of works. The 'prior consent' is agreed between the Local Authority and the contractor and may contain a range of agreed working conditions, noise limits and control measures designed to minimise or prevent the occurrence of noise nuisance from construction activities. Application for a 'prior consent' is a commonly used control measure in respect of potential noise impacts from major construction works.

2.2 National Policy Guidance

2.2.1 National Planning Policy Framework[3]

The National Planning Policy Framework (NPPF) was introduced in March 2012 replacing the former Planning Policy Guidance 24: Planning and Noise. It was revised in July 2018 and in February 2019 and this document now forms the basis of the Government's planning policies for England and how these should be applied.

[1] *Her Majesty's Stationery Office (1990) Environmental Protection Act. HMSO, London.*
[2] *Her Majesty's Stationery Office (1974) Control of Pollution Act. HMSO, London.*
[3] *Ministry of Housing, Communities and Local Government (MHCLG), 2019. National Planning Policy Framework.*

Paragraph 170 of the NPPF states planning policies and decisions should contribute to and enhance the natural and local environment by:

> *"……preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution……"*

Furthermore, Paragraph 180 of the NPPF states:

> *"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*
>
> *a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
> *b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and*
> *c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation."*

The NPPF also refers to the Noise Policy Statement for England (NPSE) (Defra, 2010).

2.2.2 National Policy Statement England[4]

The Noise Policy Statement for England (NPSE) document was published by Defra in 2010 and paragraph 1.7 states three policy 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 first two points require that significant adverse impact should not occur and that, where a noise level falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect:

> *"…all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur."* (Paragraph 2.24, NPSE, March 2010).

Section 2.20 of the NPSE introduces key phrases including "Significant adverse" and "adverse" and two established concepts from toxicology that are being applied to noise impacts:

> *"NOEL – No Observed Effect Level*

[4] *Department for Environment, Food and Rural Affairs (2010) Noise Policy Statement for England. DEFRA, London.*

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected".

Paragraph 2.21 of the NPSE extends the concepts described above and leads to a significant observed adverse effect level – SOAEL, which is defined as the level above which significant effects on health and quality of life occur.

The NPSE states:

"it is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations". (Paragraph 2.22, NPSE, March 2010).

Furthermore paragraph 2.22 of the NPSE acknowledges that:

"further research is required to increase understanding of what may constitute a significant adverse effect on health and quality of life from noise".

2.2.3 National Planning Practice Guidance for Noise[5]

The National Planning Practice Guidance for Noise[5], issued under the NPPF, states that noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment. When preparing local or neighbourhood plans, or taking decisions about new development, there may also be opportunities to consider improvements to the acoustic environment.

2.3 Guidance

The following guidance has been used for the purpose of the noise and vibration assessment:

British Standard (BS) 4142:2014 – Method for rating and assessing industrial and commercial sound[6]

BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident. Where new residential receptors are proposed close to existing industrial/commercial noise sources the standard allows for, and encourages, the use of other standards such as BS 8233 (detailed below).

British Standard (BS) 7445:2003 Parts 1 and 2 - Description and measurement of environmental noise[7,8]

This Standard provides details of the instrumentation and measurement techniques to be used when assessing environmental noise, and defines the basic noise quantity as the continuous A-weighted sound pressure level (LAeq). Part 2 of BS 7445 replicates ISO standard 1996-2.

[5] *Department for Communities and Local Government (2014) National Planning Practice Guidance Noise. DCLG, London.*
[6] *British Standards Institute (2014) BS 4142:2014 Methods for rating and assessing industrial and commercial sound. BSI, London.*
[7] *British Standards Institute (2003) BS 7445-1:2003 Description and measurement of environmental noise. Guide to quantities and procedures. BSI, London.*
[8] *British Standards Institute (2003) BS 7445-2:2003 Description and measurement of environmental noise. Guide to the acquisition of data pertinent to land use. BSI, London.*

British Standard (BS) 8233:2014 – Guidance on Sound Insulation and Noise Reduction for Buildings[9]
Provides a methodology to calculate the noise levels entering a building through facades and façade elements and provides details of appropriate measures for sound insulation between dwellings. It includes recommended internal noise levels which are provided for a variety of situations.

Calculation of Road Traffic Noise (CRTN)[10]
The Calculation of Road Traffic Noise (CRTN) document provides a method for assessing noise from road traffic in the UK and a method of calculating noise levels from the Annual Average Weekday Traffic (AAWT) flows and from measured noise levels. Since published in 1988 this document has been the nationally accepted standard in predicting noise levels from road traffic. The calculation methods provided include correction factors to take account of variables affecting the creation and propagation of road traffic noise, accounting for the percentage of heavy goods vehicles, different road surfacing, inclination, screening by barriers and relative height of source and receiver.

Design Manual for Roads and Bridges (DMRB)[11]
Volume 11, Part 3, Section 7 of the Design Manual for Roads and Bridges (DMRB) provides guidance on the environmental assessment of noise impacts from road schemes. DMRB contains advice and information relating to transport-related noise and vibration, which has relevance with regard to the construction and operational traffic impacts affecting sensitive receptors adjacent to road networks. It also provides guideline significance criteria for assessing traffic related noise impacts.

World Health Organisation (WHO) (1999) Guidelines for community noise[12]
These guidelines present health-based noise limits intended to protect the population from exposure to excess noise. They present guideline limit values at which the likelihood of particular effects, such as sleep disturbance or annoyance, may increase. The guideline values are 50 or 55dB LAeq during the day, related to annoyance, and 45 dB LAeq or 60dB LAmax at night, related to sleep disturbance.

2.4 Local Planning Policy Guidance

London Borough of Camden Council (LBC) adopted their Local Plan[13] in 2017. It contains within it the council's vision and strategy for the borough and contains policies which will be used in the determination of planning applications.

> *"**Policy A4 Noise and vibration***
>
> *The Council will seek to ensure that noise and vibration is controlled and managed. Development should have regard to Camden's Noise and Vibration Thresholds (Appendix 3).*
> *We will not grant planning permission for:*
>
> *a. development likely to generate unacceptable noise and vibration impacts; or*
> *b. development sensitive to noise in locations which experience high levels of noise, unless appropriate attenuation measures can be provided and will not harm the continued operation of existing uses.*

[9] *British Standards Institute (2014) BS 8233:2014 Sound Insulation and Noise Reduction for Buildings. BSI, London.*
[10] *Department of Transport Welsh Office (1988) Calculation of Road Traffic Noise. HMSO, London.*
[11] *The Highways Agency (2011) Design Manual for Roads and Bridges, Volume 11, Section 3, Part 7 : Noise and Vibration. The Highways Agency, Manchester.*
[12] *Berglund et al (1999) Guideline for Community Noise. WHO, Geneva.*
[13] *Camden London Borough Council (2017) Camden –Local Plan. Available: https://www.camden.gov.uk/documents/20142/4820180/Local+Plan.pdf Last Accessed: 11th April 2019.*

We will only grant permission for noise generating development, including any plant and machinery, if it can be operated without causing harm to amenity.

We will also seek to minimise the impact on local amenity from deliveries and from the demolition and construction phases of development."

3 Assessment Methodology

3.1 Study Area

This section describes the assessment methodologies, including data collation and consultation, which were used in the noise assessment.

The Study Area for the noise assessment comprises the area of the Proposed Development. The baseline noise measurement locations are illustrated on **Appendix NVB1, Figure A1**.

The primary source of noise affecting the Proposed Development is road traffic along the A4200 (Southampton Row).

3.2 Baseline Noise Survey

In order to establish the baseline conditions at the site, a noise measurement survey was undertaken at a distance of 1m from the 5th floor of the western façade of 8-10 Southampton Row in order to obtain a representative measurement of the dominant noise source affecting the site.

The survey was conducted on 16 and 17 November 2017, the results are presented in Section 4. The survey is considered to be representative of current conditions at the site.

All noise measurements were conducted with regard to the procedure and guidance contained in BS 7445, parts 1 and 2. All instrumentation was fully calibrated to traceable UKAS standards and satisfied the requirements for Class1 instruments described in BS EN 61672-1:2013. The calibration of the sound level meter (SLM) was checked before and after each of the surveys, with no significant drift in sensitivity observed.

The surveys were conducted during periods of weather favourable for noise measurements, i.e. no rainfall and wind speeds below 5m/s.

The noise levels measured during the surveys included the following noise indices:

- L_{Aeq} – the equivalent continuous sound pressure level over the measurement period;
- L_{Amax} – the maximum sound pressure level occurring within the defined measurement period;
- L_{A90} – the sound pressure level exceeded for 90% of the measurement period and is used within BS 4142 as a descriptor of background noise level; and
- L_{A10} – the sound pressure level exceeded for 10% of the measurement period.

The equivalent continuous sound pressure level (L_{Aeq}) is the conventional descriptor of environmental noise and is defined below.

$$L_{eq,T} = 10 \times \log\left[\frac{1}{T}\int \frac{\rho^2(t)\partial t}{\rho_0^2}\right] dB$$

Noise measurements are normally taken with an A-weighting (denoted by a subscript 'A') to approximate the frequency response of the human ear. The time constant of the SLM was set to 'Fast' during all measurements.

3.3 Consultation

The study area lies within the administrative boundary of London Borough of Camden (LBC). Consultation with LBC was undertaken via email[14] to agree the methods of assessment appropriate for the noise affecting the Proposed Development. The following elements of assessment were agreed by telephone:

- The Proposed Development will be assessed in accordance with the guidance in BS8233:2014, BS4142:2014 and the WHO Guidelines.

3.4 Assessment of External Noise Levels

The external daytime noise levels at the site were compared with the WHO recommended noise levels detailed in **Table NVB1**.

Table NVB1: WHO Guidelines for Community Noise – External

Specific Environment	Typical Situation	$L_{Aeq,T}$	Time base (hours)
Outdoor Living Areas	Serious annoyance, daytime evening	55	16
	Moderate annoyance, daytime evening	50	16

3.5 BS8233 Internal Habitable Room Noise Levels

Guidance on suitable internal noise levels is provided in BS 8233:2014 (Section 7.7.2, Table 4) derived from the guidance provided by the WHO. This guidance details recommended internal noise levels to ensure that adequate noise reduction occurs to reduce direct and flanking transmission across facade elements. Recommended internal noise levels are reproduced in **Table NVB2**.

Table NVB2: Recommended Internal Noise Levels – BS8233

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living rooms	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedrooms	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

The previous version of BS8233 (1999) provided guidance that noise levels in bedrooms during the night should not regularly exceed 45dB L_{Amax}. The updated BS8233 does not give a specific limit for L_{Amax} noise levels within bedrooms but it is considered prudent to adhere to the guideline level from the previous version of BS8233.

[14] *From: CLBC Planning and Public Protection, To: Royal HaskoningDHV. Subject: RE: Noise assessment, Southampton Row, Holborn – Consultation in confidence. Date: 28th December 2016.*

3.6 Assessment Assumptions and Limitations

BS8233:2014 demonstrates that the use of standard thermal glazing in residential units will reduce noise by 33dB Rw from an external free field noise level. BS8233 states that a partially open window can provide up to 15dBA attenuation from a free-field external noise to an internal noise level.

3.7 Industrial and Commercial Sound Assessment – Noise from Fixed Plant

Noise from fixed plant is typically assessed in the context of BS 4142:2014, which involves a comparison of the rating level and the measured background (L_{A90}) noise level at potential receptor locations.

BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident, and combines procedures for assessing the impact in relation to:

- The development of new industrial and/or commercial sources affecting existing receptors.

The standard applies to industrial/commercial and background noise levels outside residential buildings and for assessing whether existing and new industrial/commercial sound sources are likely to give rise to significant adverse impacts on the occupants living in the vicinity.

Assessment is undertaken by subtracting the measured background noise level from the derived rating level; the greater this difference, the greater the magnitude of the impact.

BS 4142 refers to the following:

> *"A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.*
>
> *A difference of around + 5 dB is likely to be an indication of an adverse impact, depending on the context.*
>
> *The lower the rating level relative to the measured background sound level the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context".*

When assessing the noise from a source, which is classified as the Rated Noise Level, it is necessary to have regard to the acoustic features that may be present in the noise. Section 9.1 of BS 4142 states:

> *"Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, add a character correction to the specific sound level to obtain the rating level."*

The methods for assessing whether an acoustic feature is present are:

- Subjective method;
- Objective method for tonality; and

- Reference method.

For the subjective method a rating penalty for tones of 2 – 6dB can be added; a penalty of +2dB for a tone which is just perceptible at the noise receptor, +4dB where it is clearly perceptible and +6dB where it is highly perceptible.

For impulsive noise a correction of up to 9dB can be applied; a penalty of +3dB for impulsivity which is just perceptible at the noise receptor, +6dB where it is clearly perceptible and +9dB where it is highly perceptible. For other sound features, where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of +3dB can be applied.

Where tonal and impulsive characteristics are present in the specific sound within the same reference period then both corrections can be taken into account. If one feature is dominant, then it would be appropriate to apply a single correction. Where both features are likely to affect perception and response, the corrections can be added in a linear manner.

When the specific sound has identifiable on/off conditions and the intermittency is readily distinctive against the residual acoustic environment, a penalty of +3dB can be applied.

The perception of audibility at the receptor location determines the value of the penalty to be applied.

For the objective and reference methods sections 9.3.2 and 9.3.3 and Annexes C and D of the standard should be referred to.

The determination of the specific sound level free from sounds influencing the ambient sound at the assessment location is obtained by measurement or a combination of measurement and calculation. This is to be measured in terms of the $L_{Aeq,T}$, where 'T' is a reference period of:

- 1 hour during daytime hours (07:00 hrs to 23:00 hrs); and
- 15 minutes during night-time hours (23:00 to 07:00 hrs).

Taking the above guidance into account the impact magnitude criteria presented in **Table NVB3** were determined.

Table NVB3: Operational noise impact magnitude criteria for industrial/commercial sound sources

Rating level dB $L_{Ar,Tr}$	Impact criteria
< Measured L_{A90}	No impact
= Measured L_{A90}	Low Adverse
L_{A90} + up to 5 dB	Minor Adverse
Measured L_{A90} + >5 dB	Moderate Adverse
≥ Measured L_{A90} + 10 dB	Significant (Major) Adverse

SoundPLAN noise modelling software was utilised to predict the noise effects from fixed plant associated with the development. The model was created using topographical data of the local area and the plan of the proposed extension and included nearby sensitive receptors and other surrounding buildings.

Noise output and location information for the external plant was provided by Long and Partners Building Services Consultants[15]. Indicative locations for plant equipment were provided as well as associated noise levels for each piece of equipment. This information was used for the noise modelling in SoundPLAN. It is understood that the AHU's (Air Handling Units) for the hotel and residential apartments will be situated within the plant room on Floor 8 with the CU's (Condenser Units) and emergency generator located to the roof. Twin fan extracts (EF) are to be situated on top of the AHU's. The CUs for the hotel and residential apartments are to be located on the roof of the new build portion of the development with no additional cover. All plant has been modelled as individual point sources.

Table NVB4: Equipment itinerary and associated noise breakout levels

No.	Reference	Sound Power Level dB(A) in octave bands							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
3	PUHZ-ZRP200YKA3*	52.8	52.9	59.9	63.7	66.0	51.7	54.9	47.4
2	PUZ-ZM100VKA	52.8	52.9	59.9	63.7	66.0	51.7	54.9	47.4
1	PURY-P300YNW-A*	57.3	54.4	61.9	64.7	62.0	58.7	53.5	46.9
2	PUZ-ZM100YKA	52.8	52.9	59.9	63.7	66.0	51.7	54.9	47.4
2	PUZ-ZM125VKAR1	53.8	53.9	60.8	64.8	67.0	52.7	55.8	48.4
1	PURY-EP300YNW-A	74.8	71.9	79.4	82.2	79.5	76.2	71.0	64.4
6	PURY-EM400YNW-A1	76.3	73.4	80.9	83.7	81.0	77.7	72.5	65.9

** Calculated from measured sound pressure level at a reference distance as a point source radiating in a half sphere (on the ground)*

SoundPLAN noise modelling software was utilised to predict the noise from on-site operational noise sources. In order to provide a conservative assessment plant equipment was modelled with an on-time of 100% during the daytime and 50% during the night time.

It should be noted that if plant equipment selected for the project changes from that above then the noise impact will need to be reassessed.

3.8 Significance of Effects

Overall significance has been determined by considering both the magnitude of impact sensitivity of receptor, using the matrix shown in **Table NVB5**. Effects of moderate significance or more are significant in EIA terms.

***Table NVB5**: Significance Matrix*

Sensitivity/Value of Receptor	Magnitude of Effect			
	High	**Medium**	**Low**	**Negligible**
High (England/ UK/ International)	Major	Major/ Moderate	Moderate	Negligible
Medium (County Region)	Major/ Moderate	Moderate	Moderate/ Minor	Negligible
Low (Local/ Unitary Authority	Moderate	Moderate/ Minor	Minor	Negligible

[15]To Royal HaskoningDHV, From: Long and Partners Email titled RE: Southampton Row - Stage 2 Concept Design. Date: 2nd April 2019

4 Description of Baseline Conditions

4.1 Noise Survey Results

The noise levels were measured on an unattended basis over 24hours. All measured levels are presented as free field. Measured levels have been reduced by 3dB to account for façade reflections.

Appendix NVB2 contains the unedited baseline noise data.

Table NVB6: Summary of measured free field noise levels

Period	Time	L_{Aeq} (dB)	L_{Amax} (dB)	L_{A10} (dB)
Day	1400 - 1900	67.5	91.2	66.7
Evening	1900 - 2300	65.1	93.0	65.9
Night	2300 - 0700	63.1	91.5	63.5
Day	0700 - 1400	65.8	90.9	66.6

In accordance with LBC **Policy A4** measured noise levels fall between the LOAEL and SOAEL during daytime and above the SOAEL during night-time indicating that planning will only be granted if suitable attenuation measures are applied.

Table NVB7: Summary of calculated free field noise levels

Period	Time	L_{Aeq} (dB)	L_{Amax} (dB)	L_{A10} (dB)	L_{A90}(dB)
Day	16 hours	66.3	93.0	65.9	58.8
Night	8 hours	63.1	91.5	63.5	53.5

During the daytime period the noise climate in the vicinity of the site is dominated by road traffic, pedestrians and construction works.

During the night time period the noise climate in the vicinity of the site is dominated by road traffic and pedestrians.

4.2 Vibration Survey Results

Measured baseline vibration levels are presented in **Table NVB8**.

Table NVB8: Baseline vibration level summary

Vibration Dose Value Day VDV, $_{16hr}$ ($ms^{-1.75}$)	Vibration Dose Value Night VDV, $_{8hr}$ ($ms^{-1.75}$)	Peak Particle Velocity PPV ($ms^{-1.75}$)
0.044	0.037	0.675

Measured vibration dose values indicate that, in accordance with BS6472, there is a less than low probability of adverse comment. Additionally, measured peak particle velocity levels are below the most stringent threshold stated in BS7385 transient vibration guidelines for cosmetic damage. Measured vibration dose values are also below the LBC requirements detailed in **Table C** of **Policy DP28**. Further assessment is therefore not considered within this report.

5 Impact Assessment

5.1 Construction Phase

It is inevitable that there are usually some impacts from construction works which have the potential to be of **Major Significance**; however, these impacts are short term and temporary. Mitigation measures are required and should include good practice construction management to reduce impacts from the noise generated by the construction phase of the Proposed Development.

5.2 Operational Phase

5.2.1 BS8233 Internal Habitable Room Noise Levels

An assessment was undertaken to predict noise effects at the proposed hotel and residential apartments from road traffic generated noise. A noise model of the proposed layout of the site was created within SoundPLAN and calibrated to the measured daytime and night-time $L_{Aeq,T}$ at the site based on the existing layout.

A further model was then created of the proposed layout of the site using the calibrated noise levels and hence predictions made of the $L_{Aeq,T}$ at the façade of the Proposed Development. The site layout used to create the model was provided by Matthew Lloyd Architects LLP, the appointed architects for the project (ref drawings SRH 198 to SRH 210 13th March 2019).

In order to conduct an assessment according to BS 8233:2014 noise calculations were undertaken for each façade to determine the sound insulation performance required to achieve internal noise levels specified in BS8233:2014.

The results of the SoundPLAN modelling are provided in **Table NVB9**. All results are displayed as facade levels.

Table NVB9: Summary of Calculated Facade Noise Levels, dB(A)

Facade	Floor	Daytime $L_{Aeq,16hr}$	Night time $L_{Aeq,8hr}$
North	GF	61.0	57.8
	F1	61.3	58.1
	F2	61.1	57.9
	F3	60.7	57.6
	F4	60.3	57.1
	F5	59.9	56.7
	F6	59.4	56.2
	F7	58.9	55.7
North West	GF	52.5	49.4
	F1	53.0	49.9
	F2	53.2	50.0
	F3	53.3	50.1

Facade	Floor	Daytime $L_{Aeq,16hr}$	Night time $L_{Aeq,8hr}$
	F4	53.2	50.0
	F5	53.0	49.9
	F6	52.8	49.7
	F7	52.6	49.5
South	GF	56.0	52.8
	F1	55.9	52.7
	F2	55.7	52.6
	F3	55.6	52.4
	F4	55.3	52.1
	F5	55.0	51.9
	F6	54.7	51.5
	F7	54.4	51.2
West	GF	69.9	66.7
	F1	69.6	66.4
	F2	68.7	65.6
	F3	67.9	64.7
	F4	67.1	63.9
	F5	66.3	63.1
	F6	65.6	62.5
	F7	65.0	61.9

Based upon an assumed 15dB attenuation from a partially open window (as detailed within BS8233:2014), the calculated noise levels indicate that mitigation measures will be required in order to ensure a satisfactory internal noise climate throughout the building. The sound reduction performance required of the external building fabric has been calculated to ensure that the internal noise levels specified in BS8233:2014 are achieved.

The overall sound reduction performance of a building façade is normally determined by the glazing or ventilation components as these are typically the acoustically weakest elements. **Table NVB10** details the sound reduction performance requirements for the hotel and residential apartments to ensure that the internal noise levels specified in BS8233:2014 are achieved.

Table NVB10: Required Sound Insulation Performances, dB(A)

Façade	Floor	Period	Calculated Noise Level	BS8233:2014 Specified Limit	Required Sound Insulation Performance $R_{,tra}$
North	GF	Daytime $L_{Aeq,16hrs}$	61.0	35	26.6
		Night-time $L_{Aeq,8hrs}$	57.8	30	27.6
	F1	Daytime $L_{Aeq,16hrs}$	61.3	35	26.3
		Night-time $L_{Aeq,8hrs}$	58.1	30	28.1
	F2	Daytime $L_{Aeq,16hrs}$	61.1	35	26.1
		Night-time $L_{Aeq,8hrs}$	57.9	30	27.9
	F3	Daytime $L_{Aeq,16hrs}$	60.7	35	25.7
		Night-time $L_{Aeq,8hrs}$	57.6	30	27.6
	F4	Daytime $L_{Aeq,16hrs}$	60.3	35	25.3
		Night-time $L_{Aeq,8hrs}$	57.1	30	27.1
	F5	Daytime $L_{Aeq,16hrs}$	59.9	35	24.9
		Night-time $L_{Aeq,8hrs}$	56.7	30	26.7
	F6	Daytime $L_{Aeq,16hrs}$	59.4	35	24.4
		Night-time $L_{Aeq,8hrs}$	56.2	30	26.2
	F7	Daytime $L_{Aeq,16hrs}$	58.9	35	23.9
		Night-time $L_{Aeq,8hrs}$	55.7	30	25.7
North West	GF	Daytime $L_{Aeq,16hrs}$	52.5	35	17.5
		Night-time $L_{Aeq,8hrs}$	49.4	30	19.4
	F1	Daytime $L_{Aeq,16hrs}$	53.0	35	18.0
		Night-time $L_{Aeq,8hrs}$	49.9	30	19.9
	F2	Daytime $L_{Aeq,16hrs}$	53.2	35	18.2
		Night-time $L_{Aeq,8hrs}$	50.0	30	20.0
	F3	Daytime $L_{Aeq,16hrs}$	53.3	35	18.3
		Night-time $L_{Aeq,8hrs}$	50.1	30	20.1

Façade	Floor	Period	Calculated Noise Level	BS8233:2014 Specified Limit	Required Sound Insulation Performance $R_{,tra}$
	F4	Daytime $L_{Aeq,16hrs}$	53.2	35	18.2
		Night-time $L_{Aeq,8hrs}$	50.0	30	20.0
	F5	Daytime $L_{Aeq,16hrs}$	53.0	35	18.0
		Night-time $L_{Aeq,8hrs}$	49.9	30	19.9
	F6	Daytime $L_{Aeq,16hrs}$	52.8	35	17.8
		Night-time $L_{Aeq,8hrs}$	49.7	30	19.7
	F7	Daytime $L_{Aeq,16hrs}$	52.6	35	17.6
		Night-time $L_{Aeq,8hrs}$	49.5	30	19.5
South	GF	Daytime $L_{Aeq,16hrs}$	56.0	35	21.0
		Night-time $L_{Aeq,8hrs}$	52.8	30	22.8
	F1	Daytime $L_{Aeq,16hrs}$	55.9	35	20.9
		Night-time $L_{Aeq,8hrs}$	52.7	30	22.7
	F2	Daytime $L_{Aeq,16hrs}$	55.7	35	20.7
		Night-time $L_{Aeq,8hrs}$	52.6	30	22.6
	F3	Daytime $L_{Aeq,16hrs}$	55.6	35	20.6
		Night-time $L_{Aeq,8hrs}$	52.4	30	22.4
	F4	Daytime $L_{Aeq,16hrs}$	55.3	35	20.3
		Night-time $L_{Aeq,8hrs}$	52.1	30	22.1
	F5	Daytime $L_{Aeq,16hrs}$	55.0	35	20.0
		Night-time $L_{Aeq,8hrs}$	51.9	30	21.9
	F6	Daytime $L_{Aeq,16hrs}$	54.7	35	19.7
		Night-time $L_{Aeq,8hrs}$	51.5	30	21.5
	F7	Daytime $L_{Aeq,16hrs}$	54.4	35	19.4
		Night-time $L_{Aeq,8hrs}$	51.2	30	21.2
West	GF	Daytime $L_{Aeq,16hrs}$	69.9	35	34.9

Façade	Floor	Period	Calculated Noise Level	BS8233:2014 Specified Limit	Required Sound Insulation Performance $R_{,tra}$
		Night-time $L_{Aeq,8hrs}$	66.7	30	36.7
	F1	Daytime $L_{Aeq,16hrs}$	69.6	35	34.6
		Night-time $L_{Aeq,8hrs}$	66.4	30	36.4
	F2	Daytime $L_{Aeq,16hrs}$	68.7	35	33.7
		Night-time $L_{Aeq,8hrs}$	65.6	30	35.6
	F3	Daytime $L_{Aeq,16hrs}$	67.9	35	32.9
		Night-time $L_{Aeq,8hrs}$	64.7	30	34.7
	F4	Daytime $L_{Aeq,16hrs}$	67.1	35	32.1
		Night-time $L_{Aeq,8hrs}$	63.9	30	33.9
	F5	Daytime $L_{Aeq,16hrs}$	66.3	35	31.3
		Night-time $L_{Aeq,8hrs}$	63.1	30	33.1
	F6	Daytime $L_{Aeq,16hrs}$	65.6	35	30.6
		Night-time $L_{Aeq,8hrs}$	62.5	30	32.5
	F7	Daytime $L_{Aeq,16hrs}$	65.0	35	30.0
		Night-time $L_{Aeq,8hrs}$	61.9	30	31.9

Table NVB10 has indicated that glazing and ventilation components will need to reduce the external noise level up to by 36.7dB to ensure that $L_{Aeq,\ 8hrs}$ noise levels are within the specified limit.

Windows do not reduce noise equally across the entire frequency spectrum, so the frequency content of the sound will influence the overall sound reduction performance of a given window and, by extension, the resulting noise levels within the receiving room.

Many glazing manufacturers test their products under laboratory conditions using a typical road traffic noise frequency spectrum source. The resultant measured noise attenuation, in dB, gives a very useful guide to in-situ sound reduction performance of the window for situations where road traffic noise dominates. This performance index is known as the $R_{,tra}$. It is considered more appropriate to use this index rather than the R_w (the weighted sound reduction index) as road traffic noise is the dominant noise source affecting the site.

As an example of a glazing unit that could achieve a 37dB $R_{,tra}$ performance requirement, the glazing manufacturer Saint Gobain states that its 8(14)12.8 double glazed unit has an $R_{,tra}$ of 37dB. The 8(14)12.8 notion refers to two panes of glass one 8mm thick, one 12.8mm thick separated by a 14mm air gap.

Other units may be suitable, and it is the responsibility of the glazing manufacturer to recommend and provide appropriate systems. The above analysis is provided to demonstrate that a design solution is feasible at the site for the purposes of a planning application and not for the purposes of plot-by-plot design or glazing procurement.

The detailed design of the proposed properties will affect both the required sound reduction performance and the appropriate selection of glazing units. The aspects of the detailed design that are important are the room dimensions, room finishes, window dimensions and the sound reduction performance of non-glazing elements. Further consideration of the glazing components will be required by the eventual developer of the site once the plot-by-plot design is confirmed.

Internal noise levels should be considered in the context of room ventilation requirements. Where the required sound insulation performance in **Table RVB9** is greater than 15 dB the target internal noise levels will only be achieved when windows are closed. An alternative means of ventilation will therefore be required to comply with the ventilation requirements of the Building Regulations Approved Document F. Noise levels will be elevated when windows are opened to provide purge ventilation.

The Building Research Establishment (BRE) has published an Information Paper on the acoustic performance of such passive ventilation systems. IP4/99: Ventilators: Ventilation and Acoustic Effectiveness (October 1999) details a study into the sound reduction performance of fourteen different window mounted trickle ventilators and seven different through-wall passive ventilators. The measured sound reduction performance, after taking into account flanking sound paths (i.e. sound paths that do not travel directly through the vent) and the effective area of the ventilator, ranged from 14 to 46dB. Passive vents are available that meet or exceed the sound reduction required by the glazing elements.

Adherence to the above required sound insulation performances for L_{Aeq} noise levels will also ensure that internal L_{Amax} noise levels within bedrooms at night do not regularly exceed 45dB.
It must also be noted that the above presents a worst-case assessment of noise levels at the Proposed Development.

5.2.2 External Noise Levels

An assessment of the external amenity spaces around the Proposed Development was undertaken.

Table NVB9: Summary of Calculated Facade Noise Levels details predicted noise levels at external amenity areas such as balconies, it can be seen that external noise levels are predicted to be in excess of the WHO and BS8233 threshold categories.

However, in a planning context BS8233:2014, paragraph 7.7.3.2 recognises that the WHO aspirational noise targets are not achievable in all situations:

> *"For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted."*

In addition, paragraph 7.7.3.2 of BS8233:2014 suggests:

"In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited"

5.2.3 Operational Site Noise

The baseline measurement location is considered representative of the existing and future receptors closest to and within the site. The receptors are listed in **Table NVB11** and shown on **Appendix NVB1, Figure A1**.

Table NVB11: Noise receptor location

Receptor	Description	Location	
		X	Y
NSR1	St Martins College of Art and Design and the University of Westminster (Façade 1)	530511	181614
NSR2	St Martins College of Art and Design and the University of Westminster(Façade 2)	530539	181636
NSR3	Roof terrace on Proposed Development	530538	181599

St Martins College of Art and Design, the University of Westminster and the roof terrace have been identified as having a medium sensitivity in accordance with **Table NVB5**.

5.2.4 Plant Noise

The results of the modelling exercise are presented in **Table NVB12** and **NVB13**.

As the predicted levels are below the background level at the receptors no penalty for tonality was applied as tonal elements of the noise would not be perceptible at the receptor.

Table NVB12: Predicted noise impact of proposed fixed plant - Daytime

Receptor	Floor	Calculated fixed plant rating level, free field, dB $L_{Aeq,1hr}$	Background noise level at receptor dB L_{A90}	BS 4142 Assessment	Magnitude of Effect
NSR1	GF	39.3	58.8	No Impact	Negligible
	F1	39.1	58.8	No Impact	Negligible
	F2	39.3	58.8	No Impact	Negligible
	F3	40.4	58.8	No Impact	Negligible
	F4	41.5	58.8	No Impact	Negligible
	F5	42.8	58.8	No Impact	Negligible
	F6	44.3	58.8	No Impact	Negligible
	F7	46.4	58.8	No Impact	Negligible
NSR2	GF	36.0	58.8	No Impact	Negligible

	F1	35.8	58.8	No Impact	Negligible
	F2	36.6	58.8	No Impact	Negligible
	F3	37.4	58.8	No Impact	Negligible
	F4	38.3	58.8	No Impact	Negligible
	F5	39.4	58.8	No Impact	Negligible
	F6	40.7	58.8	No Impact	Negligible
	F7	42.3	58.8	No Impact	Negligible
NSR3	n/a	46.5	58.8	No Impact	Negligible

Table NVB13: Predicted noise impact of proposed fixed plant – Night time

Receptor	Floor	Calculated fixed plant rating level, free field, dB $L_{Aeq,15min}$	Background noise level at receptor dB L_{A90}	BS 4142 Assessment	Magnitude of Effect
NSR1	GF	36.3	53.5	No Impact	Negligible
	F1	36.1	53.5	No Impact	Negligible
	F2	36.3	53.5	No Impact	Negligible
	F3	37.4	53.5	No Impact	Negligible
	F4	38.5	53.5	No Impact	Negligible
	F5	39.8	53.5	No Impact	Negligible
	F6	41.3	53.5	No Impact	Negligible
	F7	43.4	53.5	No Impact	Negligible
NSR2	GF	33.0	53.5	No Impact	Negligible
	F1	32.8	53.5	No Impact	Negligible
	F2	33.6	53.5	No Impact	Negligible
	F3	34.4	53.5	No Impact	Negligible
	F4	35.3	53.5	No Impact	Negligible
	F5	36.4	53.5	No Impact	Negligible
	F6	37.7	53.5	No Impact	Negligible
	F7	39.3	53.5	No Impact	Negligible
NSR3	n/a	43.5	53.5	No Impact	Negligible

The BS 4142 assessment detailed in **Tables NVB12** and **NVB13** determined that operation of the fixed external plant would have **No Impact** on nearby sensitive receptors during both the daytime and night time periods. Furthermore, in accordance with **Table NVB5** considering the medium sensitivity of the receptor

the likely effect would be of **Negligible** significance. Predicted rating levels are at least 10dB below background noise levels.

5.3 Residual Impacts

Incorporation of Best Practice working methods and mitigation measures would ensure that the likely residual effect at the medium sensitivity receptor identified in **Table NVB11** would be of **Negligible** significance.

6 Mitigation Measures

6.1 Construction Noise and Vibration

6.1.1 Noise Management Plan

The Control of Pollution Act and BS 5228 define a set of Best Practice working methods and mitigation measures, referred to as Best Practicable Means (BPM). Examples of these measures are:

- Where possible, locating plant so that it is screened from receptors by on-site structures, such as site cabins;
- Using mobile screening to shield receptors from particularly noisy equipment/activities;
- Using modern, quiet equipment and ensuring such equipment is properly maintained and operated by trained staff;
- Applying silencers/enclosures to particularly noisy equipment where possible;
- Ensuring that mobile plant is well maintained such that loose body fittings or exhausts do not rattle or vibrate;
- Ensuring plant machinery is turned off when not in use;
- Provide local residents with 24-hour contact details for a site representative in the event that disturbance due to noise from the construction works is perceived;
- To inform local residents about the construction works, including the timing and duration of any particularly noisy elements, and provide a contact telephone number to them;
- Try to avoid operating particularly noisy equipment at the beginning and end of the day;
- Carry out piling using the quietest methods available, i.e. augured piling instead of driven piling; and
- Keep noisy deliveries, such as skips and concrete, to the middle of the day where possible.

It is also recommended that a Construction Management Plan (CMP) is provided to cover construction working practices which can reflect "Best Practicable Means", to minimise noise from construction works.

Although the effect of adopting such methods cannot be precisely quantified, it is expected that these methods would reduce noise levels by a further 5 - 10dBA.

Management Structure and Responsibilities

The main contractor will be responsible for robust implementation of noise mitigation measures.

The key management roles with regard to the design and implementation of noise control at the construction site are to be defined and their roles should be detailed in the site CMP.

Training

The site induction programme and site rules must include good working practice instructions for site staff, managers, visitors and contractors to help minimise noise whilst working on the site.

- Good working practice guidelines/instructions could include, but not be limited to, the following points:
- Avoid unnecessary revving of engines;
- Plant used intermittently should be shut-down between operational periods;
- Avoid reversing wherever possible;
- Drive carefully and within the site speed limit at all times;
- Report any defective equipment/plant as soon as possible so that corrective maintenance can be undertaken; and
- Handle material in a manner that minimises noise.

Maintenance

Maintenance of plant should be carried out routinely and in accordance with the manufacturers' guidance.

A regular inspection of all plant and equipment could be undertaken as a minimum to ensure that:

- all plant is in a good state of repair and fully functional;
- any plant found to be requiring interim maintenance has been identified and taken out of use;
- acoustic enclosures fitted to plant are in a good state of repair;
- doors and covers remain closed during operation; and
- any repairs are being undertaken by a fully qualified maintenance engineer.

Construction Vibration Mitigation

Best management practice for vibration should be implemented to minimise vibration impacts, including:

- choosing alternative, lower impact equipment or methods where possible;
- scheduling the use of vibration-causing equipment at the least sensitive time of day;
- routing, operating or locating high vibration sources as far away from sensitive areas as possible;
- sequencing operations so that vibration-causing activities do not occur simultaneously;
- isolating the equipment causing vibration on resilient mounts; and
- keeping equipment well maintained.

7 Conclusions

The assessment has considered the suitability of the site for a hotel and residential apartments development.

The assessment concluded that the site is suitable for use as a hotel and residential apartments, subject to the provision of appropriate mitigation measures.

Using the recommended sound insulation performances detailed for assessment purposes, the 30dB $L_{Aeq,8hr}$ internal night time noise level in bedrooms and the 35 dB $L_{Aeq,16hr}$ internal daytime noise level are achieved, ensuring that internal L_{Amax} noise levels in bedrooms at night do not regularly exceed 45dB. It was concluded that openable windows cannot be relied upon as a suitable means of background ventilation (though are acceptable for purge ventilation) for hotel rooms and residential apartments while protecting the amenity of the occupiers and meeting the BS8233 $L_{Aeq,T}$ and L_{Amax} criteria and alternative measures were proposed.

A BS4142 assessment was carried out to predict the impact of the noise from plant equipment on the neighbouring sensitive receptors. The assessment concluded that the operation of fixed plant would have No Impact at nearby sensitive receptors during both the daytime and night time periods.

The detailed calculation procedure presented in Section G.2 of BS8233:2014 should be carried out at the detailed design stage to ensure that the sound insulation of the building envelope is adequate to protect the amenity of future occupiers and will meet the BS8233:2014 L_{Aeq} and L_{Amax} criteria.

Table NVB14 contains a summary of the likely significant effects of the Proposed Development.

Table NVB14: Effects Summary Table – Noise and Vibration

Potential Effect	Nature of Effect (Permanent/ Temporary)	Significance (Major/ Moderate/ Minor) (Beneficial/ Adverse/ Negligible)	Mitigation	Geographical Importance*							Residual Effects
				I	UK	E	R	C	B	L	
Construction noise and vibration impacting on existing sensitive receptors	Temporary	Major	Mitigation measures advised to employ “best practicable means” to control noise and vibration							*	Negligible
Determination of suitability of internal spaces for future patrons/occupiers of hotel and residential apartments	Permanent	Site found to be suitable	Modelling process has predicted a range of noise levels for the Proposed Development façades. Recommendations are made for suitable sound insulation to achieve internal noise levels in							*	Site found to be suitable

Potential Effect	Nature of Effect (Permanent/ Temporary)	Significance (Major/ Moderate/ Minor) (Beneficial/ Adverse/ Negligible)	Mitigation	Geographical Importance*							Residual Effects
				I	UK	E	R	C	B	L	
			accordance with BS 8233								
Operational plant noise impacting on existing/proposed sensitive receptors	Negligible	n/a	n/a						*	*	Negligible

Title
Study Area

Project
PB9205

Client
Ide Real Estate

Date	*Scale*
18/04/2019	1:500

Figure
A1

Drawn by	*Checked by*
MS	AB

Royal HaskoningDHV
Enhancing Society Together

Appendix B: Baseline Noise and Vibration Data

Start Time	Measurement Time	L_{Aeq} (dB)	L_{AFMax} (dB)	L_{A10} (dB)	L_{A90} (dB)
16/11/2016 14:00:20	00d 00:15:00.0	69.6	89.9	70.1	62.5
16/11/2016 14:15:20	00d 00:15:00.0	72.4	84.1	76.1	63.6
16/11/2016 14:30:20	00d 00:15:00.0	71.9	83.7	75.4	62.8
16/11/2016 14:45:20	00d 00:15:00.0	73.9	82.2	78.3	64.7
16/11/2016 15:00:20	00d 00:15:00.0	73.5	85.2	77.8	63.7
16/11/2016 15:15:20	00d 00:15:00.0	75.0	94.2	77.6	64.4
16/11/2016 15:30:20	00d 00:15:00.0	69.4	83.1	72.2	63.7
16/11/2016 15:45:20	00d 00:15:00.0	68.6	80.5	71.7	62.7
16/11/2016 16:00:20	00d 00:15:00.0	69.5	85.2	71.8	63.6
16/11/2016 16:15:20	00d 00:15:00.0	67.1	80.1	70.0	62.2
16/11/2016 16:30:20	00d 00:15:00.0	66.6	76.6	69.1	63.2
16/11/2016 16:45:20	00d 00:15:00.0	67.3	87.6	69.3	63.3
16/11/2016 17:00:20	00d 00:15:00.0	68.6	87.0	70.3	63.9
16/11/2016 17:15:20	00d 00:15:00.0	69.1	86.1	70.7	64.3
16/11/2016 17:30:20	00d 00:15:00.0	67.6	88.0	70.3	62.3
16/11/2016 17:45:20	00d 00:15:00.0	68.0	85.7	70.5	63.3
16/11/2016 18:00:20	00d 00:15:00.0	69.2	88.9	71.9	63.3
16/11/2016 18:15:20	00d 00:15:00.0	69.2	82.0	72.5	63.0
16/11/2016 18:30:20	00d 00:15:00.0	69.3	86.1	72.0	63.5
16/11/2016 18:45:20	00d 00:15:00.0	71.4	90.8	72.6	62.5
16/11/2016 19:00:20	00d 00:15:00.0	68.7	77.6	71.9	63.5
16/11/2016 19:15:20	00d 00:15:00.0	73.2	96.0	72.3	63.2
16/11/2016 19:30:20	00d 00:15:00.0	67.7	82.1	70.2	63.0
16/11/2016 19:45:20	00d 00:15:00.0	67.7	81.1	70.7	62.0

Start Time	Measurement Time	L_{Aeq} (dB)	L_{AFMax} (dB)	L_{A10} (dB)	L_{A90} (dB)
16/11/2016 20:00:20	00d 00:15:00.0	66.6	73.9	69.9	60.9
16/11/2016 20:15:20	00d 00:15:00.0	67.3	88.6	70.3	61.8
16/11/2016 20:30:20	00d 00:15:00.0	68.2	84.0	70.6	61.1
16/11/2016 20:45:20	00d 00:15:00.0	66.8	84.6	70.3	60.7
16/11/2016 21:00:20	00d 00:15:00.0	69.0	87.8	70.9	61.2
16/11/2016 21:15:20	00d 00:15:00.0	66.2	73.1	69.4	60.3
16/11/2016 21:30:20	00d 00:15:00.0	66.4	80.5	69.2	60.2
16/11/2016 21:45:20	00d 00:15:00.0	67.3	82.8	69.4	61.2
16/11/2016 22:00:20	00d 00:15:00.0	65.6	79.9	68.4	60.4
16/11/2016 22:15:20	00d 00:15:00.0	67.8	88.2	68.7	60.6
16/11/2016 22:30:20	00d 00:15:00.0	68.2	89.1	68.5	62.2
16/11/2016 22:45:20	00d 00:15:00.0	66.4	81.8	69.0	61.3
16/11/2016 23:00:20	00d 00:15:00.0	65.3	81.9	67.6	61.4
16/11/2016 23:15:20	00d 00:15:00.0	65.9	80.2	68.2	61.8
16/11/2016 23:30:20	00d 00:15:00.0	71.2	94.5	69.0	61.8
16/11/2016 23:45:20	00d 00:15:00.0	69.7	91.0	69.1	61.1
17/11/2016 00:00:20	00d 00:15:00.0	66.6	84.1	68.1	61.6
17/11/2016 00:15:20	00d 00:15:00.0	65.5	79.3	67.9	60.6
17/11/2016 00:30:20	00d 00:15:00.0	65.2	75.3	67.6	61.6
17/11/2016 00:45:20	00d 00:15:00.0	69.6	87.3	71.4	61.4
17/11/2016 01:00:20	00d 00:15:00.0	64.5	76.7	67.7	60.0
17/11/2016 01:15:20	00d 00:15:00.0	64.6	81.7	67.5	58.5
17/11/2016 01:30:20	00d 00:15:00.0	63.9	74.0	67.2	58.6
17/11/2016 01:45:20	00d 00:15:00.0	63.8	73.9	67.3	58.0
17/11/2016 02:00:20	00d 00:15:00.0	69.5	78.0	73.4	58.9

Start Time	Measurement Time	L_{Aeq} (dB)	L_{AFMax} (dB)	L_{A10} (dB)	L_{A90} (dB)
17/11/2016 02:15:20	00d 00:15:00.0	63.1	72.7	66.6	56.3
17/11/2016 02:30:20	00d 00:15:00.0	62.7	74.6	66.4	54.6
17/11/2016 02:45:20	00d 00:15:00.0	63.3	81.9	66.6	55.7
17/11/2016 03:00:20	00d 00:15:00.0	63.7	84.6	67.6	55.2
17/11/2016 03:15:20	00d 00:15:00.0	62.5	72.4	66.2	55.4
17/11/2016 03:30:20	00d 00:15:00.0	62.5	75.1	65.8	56.0
17/11/2016 03:45:20	00d 00:15:00.0	63.0	72.3	66.2	55.9
17/11/2016 04:00:20	00d 00:15:00.0	62.9	73.0	66.2	56.1
17/11/2016 04:15:20	00d 00:15:00.0	65.5	86.5	66.8	57.2
17/11/2016 04:30:20	00d 00:15:00.0	63.6	74.6	66.8	57.2
17/11/2016 04:45:20	00d 00:15:00.0	64.3	75.8	67.4	57.9
17/11/2016 05:00:20	00d 00:15:00.0	66.7	86.8	69.1	58.2
17/11/2016 05:15:20	00d 00:15:00.0	66.1	84.9	68.8	58.7
17/11/2016 05:30:20	00d 00:15:00.0	65.9	81.9	69.3	59.5
17/11/2016 05:45:20	00d 00:15:00.0	65.6	83.5	68.5	60.9
17/11/2016 06:00:20	00d 00:15:00.0	65.6	75.5	68.5	59.8
17/11/2016 06:15:20	00d 00:15:00.0	67.1	78.0	70.1	61.5
17/11/2016 06:30:20	00d 00:15:00.0	67.4	76.8	70.0	63.3
17/11/2016 06:45:20	00d 00:15:00.0	66.6	76.6	69.5	62.2
17/11/2016 07:00:20	00d 00:15:00.0	67.5	76.1	70.2	63.7
17/11/2016 07:15:20	00d 00:15:00.0	67.4	79.3	70.1	62.9
17/11/2016 07:30:20	00d 00:15:00.0	70.2	92.8	71.2	62.8
17/11/2016 07:45:20	00d 00:15:00.0	70.6	93.9	70.8	63.6
17/11/2016 08:00:20	00d 00:15:00.0	67.2	80.6	69.9	62.7
17/11/2016 08:15:20	00d 00:15:00.0	68.4	77.1	70.9	64.8

Start Time	Measurement Time	L_{Aeq} (dB)	L_{AFMax} (dB)	L_{A10} (dB)	L_{A90} (dB)
17/11/2016 08:30:20	00d 00:15:00.0	69.3	82.7	71.7	65.3
17/11/2016 08:45:20	00d 00:15:00.0	68.3	79.6	70.4	65.5
17/11/2016 09:00:20	00d 00:15:00.0	68.6	86.4	70.9	64.3
17/11/2016 09:15:20	00d 00:15:00.0	67.7	78.7	70.7	63.0
17/11/2016 09:30:20	00d 00:15:00.0	69.4	90.3	70.5	62.9
17/11/2016 09:45:20	00d 00:15:00.0	69.0	83.1	71.4	65.0
17/11/2016 10:00:20	00d 00:15:00.0	70.7	81.0	73.1	66.6
17/11/2016 10:15:20	00d 00:15:00.0	69.5	90.3	70.7	64.5
17/11/2016 10:30:20	00d 00:15:00.0	69.0	83.5	70.8	66.2
17/11/2016 10:45:20	00d 00:15:00.0	68.3	83.7	70.5	64.8
17/11/2016 11:00:20	00d 00:15:00.0	68.0	81.0	70.5	64.5
17/11/2016 11:15:20	00d 00:15:00.0	67.8	90.8	69.4	65.0
17/11/2016 11:30:20	00d 00:15:00.0	67.7	80.1	69.5	64.4
17/11/2016 11:45:20	00d 00:15:00.0	67.4	78.7	69.7	64.2
17/11/2016 12:00:20	00d 00:15:00.0	67.7	83.2	69.4	65.2
17/11/2016 12:15:20	00d 00:15:00.0	68.2	89.0	69.4	64.6
17/11/2016 12:30:20	00d 00:15:00.0	73.0	91.5	73.1	65.3
17/11/2016 12:45:20	00d 00:15:00.0	68.4	86.6	70.2	65.6
17/11/2016 13:00:20	00d 00:15:00.0	67.9	80.2	69.5	65.9
17/11/2016 13:15:20	00d 00:15:00.0	67.8	82.8	69.9	65.2
17/11/2016 13:30:20	00d 00:15:00.0	67.9	83.0	70.0	64.4
17/11/2016 13:45:20	00d 00:01:50.0	67.8	79.5	69.9	63.5

DAYTIME VDV	1 Hour		
Hour 1	0.018	0.02	0.019
Hour 2	0.019	0.021	0.02
Hour 3	0.019	0.022	0.02
Hour 4	0.019	0.022	0.02
Hour 5	0.019	0.022	0.02
Hour 6	0.019	0.022	0.02
Hour 7	0.019	0.022	0.02
Hour 8	0.019	0.022	0.02
Hour 9	0.019	0.022	0.02
Hour 10	0.019	0.022	0.02
Hour 11	0.019	0.022	0.02
Hour 12	0.019	0.022	0.02
Hour 13	0.019	0.022	0.02
Hour 14	0.019	0.022	0.02
Hour 15	0.019	0.022	0.02
Hour 16	0.019	0.022	0.02
VDV 16hr	0.044	$ms^{-1.75}$	
NIGHT-TIME VDV	1 Hour		
Hour 1	0.02	0.022	0.02
Hour 2	0.019	0.022	0.02
Hour 3	0.02	0.022	0.02
Hour 4	0.02	0.022	0.02
Hour 5	0.02	0.022	0.02
Hour 6	0.019	0.022	0.02
Hour 7	0.019	0.022	0.02
Hour 8	0.019	0.022	0.02
VDV 8hr	0.037	$ms^{-1.75}$	
PPV	0.675	$ms^{-1.75}$	

Appendix C: Acoustic Terminology

Term	Description
Decibel (dB)	A unit of noise level derived from the logarithm of the ratio between the value of a quantity and a reference value. It is used to describe the level of many different quantities. For sound pressure level the reference quantity is 20 µPa, the threshold of normal hearing is 0dB, and 140dB is the threshold of pain. A change of 1dB is only perceptible under controlled conditions. Under normal conditions a change in noise level of 3dB(A) is the smallest perceptible change.
dB(A)	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise level in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).
$L_{Aeq,T}$	The equivalent continuous sound level – the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period (T). $L_{Aeq,\ T}$ is used to describe many types of noise and can be measured directly with an integrating sound level meter.
$L_{A10,T}$	The A weighted noise level exceeded for 10% of the specified measurement period (T). L_{A10} is the index generally adopted to assess traffic noise.
$L_{A90,\ T}$	The A weighted noise level exceeded for 90% of the specified measurement period (T). In BS 4142:2014 it is used to define the 'background' noise level.
L_{Amax}	The maximum A-weighted sound pressure level recorded during a measurement.
L_{Amin}	The minimum A-weighted sound pressure level recorded during a measurement.
R_w	The weighted sound reduction index, Rw, is a single figure description of sound reduction index which is defined in BS EN ISO 717-1: 1997. The Rw is calculated from measurements in an acoustic laboratory to BS EN ISO 140-3:1997 and ratings to BS EN ISO 717-1:1997. Sound insulation ratings derived from site (which are invariably lower than the laboratory figures) are referred to as the R'w ratings (apparent weighted sound reduction index) and measured to BS EN ISO 140-4:1998