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ENVIRONMENTAL NOISE & VIBRATION ASSESSMENT

PROPOSED STUDENT AND RESIDENTIAL DEVELOPMENT, BATTERSEA PARK ROAD, LONDON

REPORT REFERENCE NO. J003701-5443-DH-07

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1.0 SUMMARY

PDA Ltd was commissioned by Watkin Jones to carry out an environmental noise and vibration assessment report for the proposed new build student and residential accommodation development at Battersea Park Road, London. This report is in support of the application for Phased Full Planning Permission for: Demolition of existing building and construction of three new buildings, together comprising Residential (Use Class C3) and Student Accommodation (Sui Generis) along with Commercial, Business and Service (Use Class E) and/or Local Community and Learning (Class F) floorspace. Associated works include hard and soft landscaping, car parking and new vehicular access / servicing, and other ancillary works.

The proposed development consists of 3 no. 12-22 storey blocks consisting of 762 no. student bedrooms along with 55 no. residential units, all with ancillary management facilities.

A noise level survey has been undertaken at the site representative of daytime and night-time hours. The local noise climate is dominated by road traffic noise from Battersea Park Road (A3205) and to a lesser extent 'A-road' throughout the day and night time. Contributions from surrounding local roads include cars, buses, lorries and motorbikes. Rail noise dominates the south of the site with regular pass-bys throughout the day and lesser in the night

Based upon the measured and predicted noise levels, supplemented with previous railway noise data, calculations have been undertaken for the Bedrooms and Living Spaces to evaluate the internal noise levels. Recommendations are given for glazing, ventilation and building façade elements to meet the internal noise level requirements of good practice guidance given in BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings. Calculations suggest that the noise level criteria of BS8233:2014 can be achieved within the proposed accommodation. Calculations have also been carried out to assess the external amenity spaces where it is noted that, a compromise in noise level is warranted when living in a highly developed urban area and therefore considered acceptable in the context of BS8233:2014. In addition, an assessment has been carried out in regards to Approved Document O, which concludes that an alternative means of ventilation is required rather than relying on open windows or open areas during night-time periods.

In addition a vibration survey has been undertaken running concurrently with the noise measurements. The measured and predicted vibration levels are well below the '*Low probability of adverse comment*' criterion of BS 6472 for both day and night time periods and as such, BS 6472 would suggest that for levels below the ranges, adverse comment is not expected.

2.0 SITE DESCRIPTION

The proposed development consists of 3 no. 12-22 storey blocks consisting of 762 no. student bedrooms along with 55 no. residential units, all with ancillary management facilities. The current site is currently shared by Booker's warehouse and a disused car servicing unit. Both are which are understood to be demolished to allow for the new proposed development.

The locality of the proposed site is a densely urban areas with multiple road networks and high rise buildings of residential and commercial use. Battersea Park Road (A3205) runs across the immediate north of the site with the 'A-road' running immediately to the east. The south of the site is bordered by the Vauxhall trainline. Construction sites are located directly to the west and approximately 120m to the east of site.

A site plan showing the location of the site and surrounding local area is shown in Figure 1 below.

Figure 1. Location with proposed site outlined.

3.0 NOISE ASSESSMENT CRITERIA

3.1 National Planning Policy Framework

National Planning Policy is guided by the National Planning Policy Framework (NPPF) updated in December 2023. With regard to Noise the Framework states the following;

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 or land instability.*

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:

- *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;*

- *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.*

The terms '*significant adverse*' and '*adverse*' impacts are defined in the explanatory notes of the 'Noise Policy Statement for England (NPSE) which states;

There are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation. They are:

NOEL – No Observed Effect Level

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.

Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.

The notes also offer an explanation of the term 'adverse impacts' as follows;

… refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development (paragraph 1.8). This does not mean that such adverse effects cannot occur.

Although no specific noise limits for LOAEL and SOAEL have been defined, in 2014 the UK Government published a planning practice guidance document for noise which indicates where these limits fall with relation to the perception of noise, updated in July 2019. A summary is reproduced in Section 4.2 below, and the full document is published at https://www.gov.uk/guidance/noise--2. It is considered that guidance from other acoustic standards may be employed to determine suitable levels within the overall principal of the National Planning Policy Framework.

3.2 Planning Practice Guidance – Noise

The UK Planning Practice Guidance on noise offers further guidance on the typical levels which constitute the NOEL, LOAEL and SOAEL, reproduced in the table below.

Table 1. Planning Practice noise level guidance

Response	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not Present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

3.3 BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

Dwelling houses, flats and rooms in residential use

British Standard 8233:2014, *Guidance on Sound Insulation and noise reduction for buildings*, gives guidance on internal noise levels within dwellings, flats and rooms in residential use when unoccupied. The following criteria are for Living and Dining Rooms for daytime use and Bedrooms for night time.

Table 2. BS8233 recommended indoor ambient noise levels

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	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 $L_{Aeq,8hour}$

It should however be stressed that the above criterion relates to steady noise, in this case from road traffic etc., excluding unusual noise events departing from the typical noise character of the area.

In addition BS 8233 suggests, '*regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values'.*

With regard to external areas of residential developments BS8233:2014 states the following;

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

3.4 WHO Guidelines for Community Noise

In 1999, the WHO (World Health Organisation) published Guidelines for Community Noise, stating the following internal noise levels are applicable within dwellings.

Table 3. WHO Guidelines for Community Noise criteria

Specific Environment	Critical Health Effect(s)	L_{Aeq} dB	Time Base (hours)*
Dwelling, indoors	Speech intelligibility & moderate annoyance, daytime & evening	35	16
Inside bedrooms	Sleep disturbance, night time	30	8

* Typically taken to be daytime/evening - 07:00 – 23:00 hours and night time 23:00 – 07:00 hours.

In addition to the above continuous equivalent noise levels, WHO guidelines indicates that exceedances of 45 dB L_{Amax} for single sound events should be limited to no more than 10 – 15 times per night, when measured with a 'fast' time weighting.

3.5 BS6472:2008 Guide to Evaluation of human exposure to vibration in buildings

BS6472:2008 develops guideline limiting vibration criteria for residential and other premises. BS6472 uses the Vibration Dose Value (VDV) parameter to assess the probability of adverse comments when human subjects are exposed to vibration from typical environmental sources of vibration (e.g. rail traffic). BS6472 gives the following envelope limiting values to describe varying degrees of perception:

Table 4. BS6472 Guideline Vibration Limiting Criteria for residential use

VDV Period	VDV $ms^{-1.75}$		
	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Residential Buildings 16hr day 07:00 – 23:00 hours	0.2 – 0.4	0.4 – 0.8	0.8 – 1.6
Residential Buildings 8hr night 07:00 – 23:00 hours	0.1 – 0.2	0.2 – 0.4	0.4 – 0.8

BS6472 states that for levels below the ranges in the table above adverse comment is not expected.

3.6 Re-radiated Structure Borne Noise

Re-radiated structure borne noise has the potential to cause disturbance if it is generated at a sufficiently loud level. In the absence of any local or national government guidance with regards to structure-borne noise due to subterranean rail movements, appropriate design criteria for structure-borne noise in this case would be that given in the American Public Transit Association (APTA) Guideline for Design of Rapid Transit Facilities, Section 2.7, Noise and Vibration, 1981. The guidelines are reproduced in the Table below:

Table 5: APTA Guidelines for Acceptable Ground-Borne Noise Within Residential Dwellings

Community Area	Maximum A-weighted Sound Pressure Level dB L_{ASMAX}	
	Single Family Dwelling	Multi-Family Dwelling
Low Density Residential	30	35
Average Density Residential	35	40
High Density Residential	35	40
Commercial	40	45
Industrial / Highway	40	45

3.7 Wandsworth Council's Local Plan 2023 – 2038, Adopted July 2023

Wandsworth Council's Local Plan 2023 – 2038, Adopted July 2023 is the key planning document for the borough. It sets our a 15-year vision and framework for the future development of the borough, addressing the needs and opportunities in relation to housing, the economy, community facilities and infrastructure.

In respect of noise, the Policy LP14 "Air Quality, Pollution and Managing Impacts of Development provides" provides reference to noise and vibration.

3.7.1 Policy LP 14 – Air Quality, Pollution and Managing Impacts of Development provides

Policy LP 14 states the following in relation to noise:

The Council will require the reduction, management, and / or mitigation of noise and vibration that would arise as a result of development to ensure that the health and quality of life of existing and future residents, especially within noise sensitive buildings, is protected. Development proposals should have

regard to Policy D14 of the London Plan, and the following will be required to be demonstrated as part of a noise assessment:

1. *The impact of any new plant and equipment upon both receptors and general background noise levels.*
2. *The provision of effective mitigation measures where noise resulting from a development needs to be controlled and managed, including through the promotion of good acoustic and site design and use of new technologies.*
3. *Time limits and restrictions for activities where noise cannot be sufficiently mitigated, including through the use of planning conditions.*
4. *Measures to protect the occupiers of new developments from existing sources, without harming the successful continued operation of existing uses in line with the Agent of Change principle set out in the London Plan Policy D13.*

3.8 The London Plan (2021)

It is noted that the Policy LP14 described above states that development proposals should have regard to Policy D14 of the London Plan.

The London Plan 2021 is the Spatial Development Strategy for Greater London. It sets out a framework for how London will develop over the next 20-25 years and the Mayor's vision for Good Growth.

Within Policy D14 it states the following with reference to noise:

3.8.1 Policy D14 Noise

Policy D14 states the following:

"A In order to reduce, manage and mitigate noise to improve health and quality of life, residential and other non-aviation development proposals should manage noise by:

1) avoiding significant adverse noise impacts on health and quality of life

2) reflecting the Agent of Change principle as set out in Policy D13 Agent of Change

3) mitigating and minimising the existing and potential adverse impacts of noise on, from, within, as a result of, or in the vicinity of new development without placing unreasonable restrictions on existing noise-generating uses

4) improving and enhancing the acoustic environment and promoting appropriate soundscapes (including Quiet Areas and spaces of relative tranquillity)

5) separating new noise-sensitive development from major noise sources (such as road, rail, air transport and some types of industrial use) through the use of distance, screening, layout, orientation, uses and materials – in preference to sole reliance on sound insulation

6) where it is not possible to achieve separation of noise-sensitive development and noise sources without undue impact on other sustainable development objectives, then any potential adverse effects should be controlled and mitigated through applying good acoustic design principles

7) promoting new technologies and improved practices to reduce noise at source, and on the transmission path from source to receiver."

3.9 Approved Document O (ADO)

Approved Document O (ADO) 2021, provides guidance on meeting the requirements of the Building Regulations 2010, part 'O1 Overheating mitigation'. The aim of the Building Regulations part O1 is to protect the health and welfare of occupants of the building by reducing the occurrence of high indoor temperatures.

Building Regulations part O1 requires that dwellings, institutions or any other buildings containing one or more rooms for residential purposes (other than a room in a hotel) to:

(a) Limit unwanted solar gains in summer:

(b) Provide an adequate means to remove heat from the indoor environment

However in meeting the obligations of ADO the buildings overheating mitigation strategy for use by occupants must consider 'Noise at night' in addition to other non-noise related considerations.

In regards to 'Noise at night', ADO stipulates the following.

In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).

Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.

a. 40dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am).

b. 55dB L_{AFmax}, more than 10 times a night (between 11pm and 7am)

It should be noted that the above noise limits are with reference to internal noise levels within a bedroom. BS 8233 advises that based on a partially opened window noise at the external façade of the building will reduced by approximately 15 dB. Therefore ADO infers that windows will be required to remain closed when the external noise climate exceeds the following external noise limits.

55dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am)

70dB L_{AFmax}, more than 10 times a night (between 11pm and 7am)

Subsequently, where windows are required to be closed at night (due to the above noise limits being exceeded), the overheating mitigation strategy as required by ADO must provide an alternative method to removing heat other than relying on windows remaining open.

4.0 SURVEY DETAILS AND RESULTS

4.1 Environmental Noise Survey

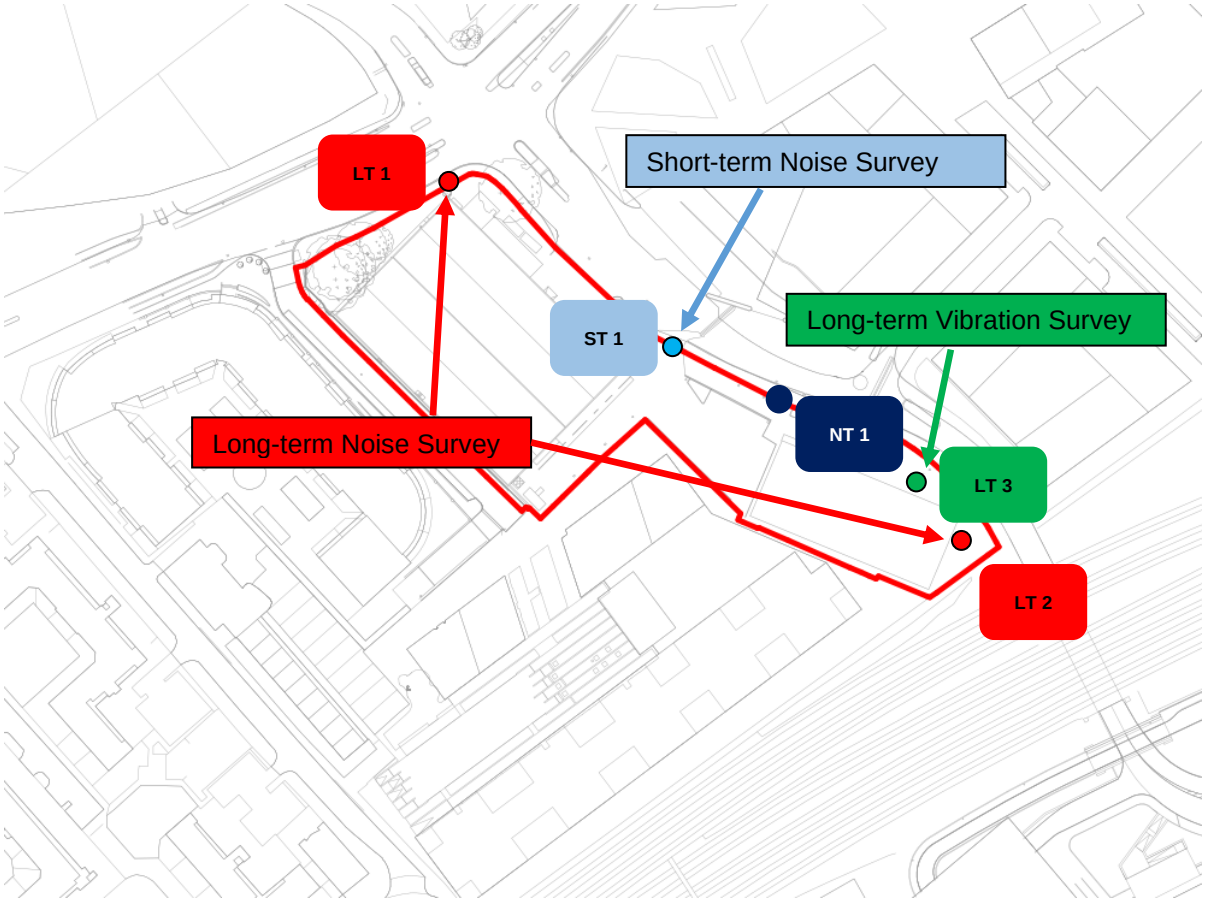
A noise level survey was undertaken at the site between 12:15 hours on Tuesday 1st February and 13:10 hours on Wednesday 2nd February 2022; the noise level surveys were chosen to be representative of daytime and night time hours.

Long-term (LT) noise measurements were taken at two different locations on site and a short-term (ST) noise measurement was conducted at the east boundary of the site as can be seen in Figure 2. A long-term vibration survey was also carried out as indicated below.

An additional noise level survey was also conducted on Wednesday 6th April between 13:12 hours and 09:27 hours on Thursday 7th April 2022. The purpose of this survey was to further assess the night-time

noise levels after updated comments on night-time activity from the New Covent Garden Market. This is indicated by NT1 below.

Figure 2. Noise and vibration survey locations.



The measurement positions are detailed as follows:

- LT 1 – microphone located on a mast approximately 3m above ground level at the northern boundary. This was deemed to have no reflective surfaces affecting the noise level measurements.
- LT 2 – microphone located on a mast approximately 10m above ground level at the southern boundary. This was deemed to have no reflective surfaces affecting the noise level measurements.
- ST 1 – Microphone located on a tripod approximately 1.5m above ground level at the eastern boundary. This was deemed to have no reflective surfaces affecting the noise level measurements.
- NT 1 – microphone located on a mast approximately 3m above ground level at the eastern boundary. This was deemed to have no reflective surfaces affecting the noise level measurements.

The 1st and 2nd February and 6th and 7th April measurements were made and partially attended by Mr David Hible of PDA Ltd. Measurements were of continuous 5 minute samples. The survey was conducted using 2x NTi XL2; one located at LT 2 and the second used for ST 1 and LT 1. An NTi XL2 was also used for NT 1. Calibration certificates for the sound level meters are held.

The NTi meters are Class 1 frequency response as per BS EN 61672-1:2003. For both surveys the sound level meters were field calibrated both before and after the measurement period, during which time no significant deviation from the calibrated level was observed. The sound level meters were fitted with a microphone windshield at all times.

The microphone of the sound level meter at each position was mounted on a mast/tripod at least 3m from surrounding structures and can be assumed to be a free field measurement. All measurements were undertaken with a fast time-weighting and broadband statistics were measured throughout. In addition, octave band frequency spectra were recorded.

The weather during the noise and vibration surveys of the 1st and 2nd February was dry, with wind speeds reported at 3-5m/s. Temperatures were between 8-12 degrees Celsius with mainly clear skies at approximately 10% coverage.

The weather during the noise survey on 6th and 7th April was dry, with wind speeds at 4-5m/s. Temperatures were between 10-13 degrees Celsius with mainly clear skies and approximately 20% cloud coverage.

Noise Sources

The local noise climate is dominated by road traffic noise from Battersea Park Road (A3205) and to a lesser extent 'A-road' throughout the day and night time. Contributions from surrounding local roads include cars, buses, lorries and motorbikes. Rail noise dominates the south of the site with regular pass-bys throughout the day and lesser in the night.

Other intermittent noises sources were from the surrounding construction sites, predominately to the east of site. Vehicles using the Booker's carpark were also frequent throughout the day-time periods. Overhead aircraft were frequent throughout the day and night-time periods.

4.2 Vibration

The vibration survey was conducted using a Svan 958 vibration analyser. The Svan 958 vibration analyser is a continuous monitoring vibration analyser with a tri-axial accelerometer sensor. The Svan 958 was set-up at Position LT 3 on an area of tarmac ground surface at the closest point to the existing railway line. The location was judged to be representative of the proposed buildings. Vibration data was recorded between 12:11 hours on Tuesday 1st February and 12:14 hours on Wednesday 2nd February 2022. The vibration analyser was set to measure continuously and calculate VDV values over 10-minute periods throughout the measurement periods. The measured data has been processed to determine the 16-hour daytime period from 07:00 – 23:00 hours and 8-hour night-time period from 23:00 – 07:00 hours.

4.3 Measurement Results

Environmental Noise

Measurement positions on site are shown on Figure 2 section 5.1 of this report. A summary of the results is given below:

Table 5. Summary of environmental noise measurements – LT 1 – 1/2 February 2022.

Position	Time Period (hh:mm)	Duration (hh:mm)	$L_{Aeq,T}$ (dB)	Typical Night-time $L_{Amax,5mins}$ (dB)[1]
LT 1	Day 1/2/2022 14:10 – 23:00 2/2/2022 07:00 – 13:01	14:51	71	-
	Night 23:00 – 07:00	08:00	68	82

Notes:
1 Typical L_{Amax} noise levels are those not exceeded more than 10 times over the whole night-time period.

Table 6. Summary of environmental noise measurements – LT 2

Position	Time Period (hh:mm)	Duration (hh:mm)	$L_{Aeq,T}$ (dB)	Typical Night-time $L_{Amax,5mins}$ (dB)[1]
LT 2	Day 1/2/2022 12:15 – 23:00 2/2/2022 07:00 – 12:27	16:12	59	-
	Night 23:00 – 07:00	08:00	54	67

Table 7. Summary of environmental noise measurements – ST 1

Position	Time Period (hh:mm)	Duration (hh:mm)	$L_{Aeq,T}$ (dB)	Typical Night-time $L_{Amax,5mins}$ (dB)[1]
ST 1	1/2/2022 Day 12:40 – 13:40	1:00	64	-

Table 8. Summary of environmental noise measurements – NT 1

Position	Time Period (hh:mm)	Duration (hh:mm)	$L_{Aeq,T}$ (dB)	Typical Night-time $L_{Amax,5mins}$ (dB)[1]
NT 1	6/4/2022 – 7/4/2022 Night 23:00 – 07:00	8:00	62	82

4.4 Vibration Results

A summary of the vibration measurements in terms of VDV $ms^{-1.75}$ is given in the Table below. Note that the measurements are split into daytime [07:00 – 23:00] and night-time [23:00 – 07:00] periods. The 10 minute measurements were combined to calculate the overall VDV for both the daytime and the night-time periods.

$$VDV(T) = \sqrt[4]{\sum (VDV(dT))^4}$$

Table 9. Summary of Vibration Measurements VDV $ms^{-1.75}$

Measurement Location	Period	VDV $m/s^{1.75}$		
		X axis (horizontal)	**Y axis (horizontal)**	**Z axis (vertical)**
LT 3	Day 1/2/2022 12:11 – 23:00 2/2/2022 07:00 – 12:24	0.005	0.003	0.018
	Night 23:00 – 07:00	0.003	0.003	0.010

4.5 Railway Line Previous Measurement Data

It should be noted that the measurements at LT 2 were potential shielded from the rail traffic due to obstructions between rail tracks. In order to validate the accuracy of the measurement data for the impact of the trainline at LT 2, previous measurements taken by PDA of the same train line located at Miles St, Vauxhall on 15th June 2021 between 19:09 hours and 19:45 hours. Please note that this measurement location site is approximately 1km from the proposed site, but was monitoring the same train lines. The microphone was positioned at 5m from the train line out the window of a 6th floor development. The microphone was approximately 10m above the rail line with an uncompromised view. As summary of the results can be seen below:

Table 10. Previously measured Vauxhall rail line data.

Parameter	Octave Band Noise Level Data (dB[A])								Noise Level (dB[A])
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	
L_{Aeq}	43	52	61	67	69	68	68	66	**75**
L_{Amax}	61	65	72	86	85	84	84	83	**91**

5.0 NOISE PROPAGATION AND IMPACT ASSESSMENT

Using the measured and predicted noise level data above, a 3-dimensional computer noise model has been constructed using SoundPlan noise modelling software to determine the noise level impact upon the proposed development. All calculations have followed the methodology contained within ISO 9613-2:1996 *Attenuation of sound during propagation outdoors - Part 2: General method of calculation*. The topographical data for the site and surrounding area is taken from Google Maps Terrain height data.

The model has been calibrated to the noise levels measured on-site. It is noted that despite the measurements being undertaken at LT2 on a 10m mast it is not known whether it had line of site from the railway line. Any potential shielding from walls or other obstructions could have an impact on the measured level. As the previously measured railway line data (15/06/21) had unobstructed view of the railway line and as it was measuring the same railway activity this data has been used to model the railway noise. This has been calibrated within the model by positioning a receiver at the same distances of that measured on 15/06/21.

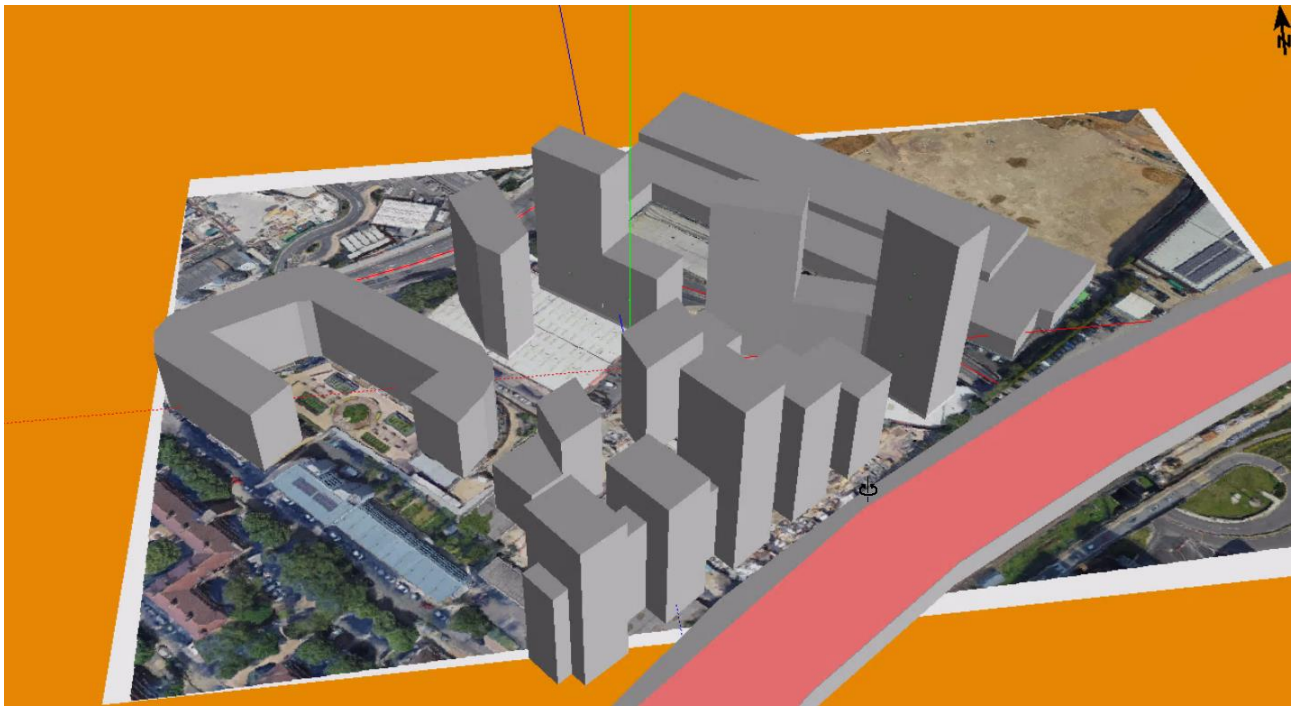
A ground absorption coefficient of 0 has been used to take into account the predominantly hard surfaces of roads, hard standing, etc. The noise map model shows reasonable correlation with the measured survey data.

Figure 3. SoundPlan noise model calibration map

NB. Noise Levels for each position are given as [Day L_{Aeq}][Night L_{Aeq}][-][Night L_{Amax}]

From this, the proposed layout of the new buildings has been added. Noise levels incident upon the proposed building are calculated at 1.5m above ground level and 3m for each additional floor for the 12-22 storey student accommodation. We have included for the current development elevations located at Sleaford Street to the south-west of the proposed site. The SoundPLAN model would suggest the following noise levels calculated at the façade of the proposed buildings.

Figure 4. SoundPLAN noise model with the proposed buildings



5.1 Discussion

It is PDA's experience that developments with the measured noise levels above are suitable for residential development provided that adequate acoustic attenuation is provided to habitable areas. Considering the acoustic weak points of a building façade, typically the glazing and the ventilation elements, calculations have been undertaken to determine specifications for these building elements and the internal noise levels. These levels are compared with the criteria detailed in Table 11 below, derived from the guidance in Section 4.

Table 11. Proposed internal noise level criteria

Space	$L_{Aeq,T}$ dB	Time Base (hours)
Living Rooms/Bedrooms, Daytime	35	16 (07:00 – 23:00 hours)
Bedrooms, Night time	30	8 (23:00 – 07:00 hours)

In addition for bedrooms at night time (23:00 – 07:00 hours) individual noise events should not normally exceed 45 dB L_{Amax}. when limited to no more than 10 – 15 times per night.

5.2 Vibration Assessment

Vibration was measured at Position LT3 on an area of concrete ground surface at the closest point to the existing railway line. The location was judged to be representative of the proposed buildings. No amplification has been applied to the x and y axes. These amplification factors are in accordance with Association of Noise Consultants guidelines for the assessment of ground-borne vibration.

The measured and predicted vibration levels are compared to the criteria of BS 6472 in Table 11 below.

Table 12. Comparison of measured vibration with BS 6472 criteria

Day	Period	BS 6472 'Low probability of adverse comment' criterion [VDV]	Maximum predicted vibration [VDV] $ms^{-1.75}$		
			X	Y	Z
Tues/Weds 16/17 Nov	Residential Buildings 16hr day 07:00 – 23:00 hours	0.2 – 0.4	0.005	0.003	0.018
Tues/Weds 16/17 Nov	Residential Buildings 8hr night 07:00 – 23:00 hours	0.1 – 0.2	0.003	0.003	0.010

The measured and predicted vibration levels are well below the '*Low probability of adverse comment*' criterion of BS 6472 for both day and night time periods and as such, BS 6472 would suggest that for levels below the ranges in the table, adverse comment is not expected.

5.3 Re-Radiated Noise Assessment

The ANC Guidelines describe various corrections and transfer functions with regards to propagation of structure borne vibration in buildings. These include but are not limited to attenuation/amplification within different foundation types, slab resonance and attenuation from floor to floor. The most onerous structural coupling and correction factors have been assumed such that our assessment is conservative. The corrections are as summarised below:

- Coupling attenuation (large masonry on piled foundations) = 5 – 10 dB
- Floor-to-Floor attenuation = 1 - 2 dB / 31 – 125 Hz
- Slab resonance = +6 dB / 20 – 30 Hz

Having accounted for the corrections above the following equation was used to predict the re-radiated noise into the 1st floor dwellings:

$$Lp = L_V - 32\,dB$$

Where:

L_p = The RMS sound pressure level during a train pass event

L_v = The RMS vibration velocity level in dB re: 1 x 10^{-9} ms^{-1}

The re-radiated noise have been predicted utilising the 10 highest measured L_{ASMax} velocity levels, the results suggest that the noise levels will be between 35-43 dB L_{ASMax} on the piled and raft foundations. It is noted that 43 dB exceeds the criteria in Section 4.6. However, as this level occurs only once and is significantly higher than the other measurements, we would consider that this is likely to be an anomaly due to extraneous sources and has been excluded from this assessment.

6.0 NOISE LEVEL PREDICTIONS

Based upon the measured noise levels in Section 5, calculations have been undertaken to determine internal noise levels for the proposed student accommodation. The proposed site and internal layouts are derived from the received Glenn Howells Architects drawings, ref. '*2278-230308-Battersea Park Road – Design Freeze Pack'* dated 8th March 2023 which encompasses all rooms across each block.

A night-time L_{max} value for the 'A-road', which was a short term day-time measurement, has been calculated by comparing the ninetieth percentile measured at both ST1 and LT1 for a similar day-time period and then assessing against the level difference between the day-time average L_{max} and the 10th loudest nigh-time at LT1. This resulted in a reduction of 4dB, therefore the night-time L_{max} for 'A-road' is 81.4dB(A). In order to verify this prediction, the 10th loudest night-time L_{max} has been calculated from

measurements made on 6th to 7th April 2022 at NT 1. This results in 81.6dB(A) so we would therefore consider this level to be typical of night-time activity.

6.1 Glazing and Ventilation Attenuation Requirements

The dominant paths for noise transfer to the interior of buildings are generally the glazing and ventilation elements of the façade constructions. Due to the requirements of Approved Document O, it is our understanding that the development is to be mechanically ventilated and therefore trickle vents will not be required. Thus, we have not included for ventilation openings within our assessment though it should be ensured that any proposed fans for rapid ventilation should be assessed for their acoustic performance to ensure the sound reduction performance of the entire façade is not compromised.

The calculation of noise break-in to the residential rooms has been undertaken in accordance with the calculation methods of BS EN 12354-3:2000 *Building Acoustics – Estimation of acoustic performance of buildings from the performance of elements. Part 3: Airborne sound insulation against outdoor sound*, in octave bands. Reverberation time is 0.5 seconds as per the BS EN 12354-3 reference time for dwellings.

Figure 5. General site layout for the proposed accommodation – Lower floors

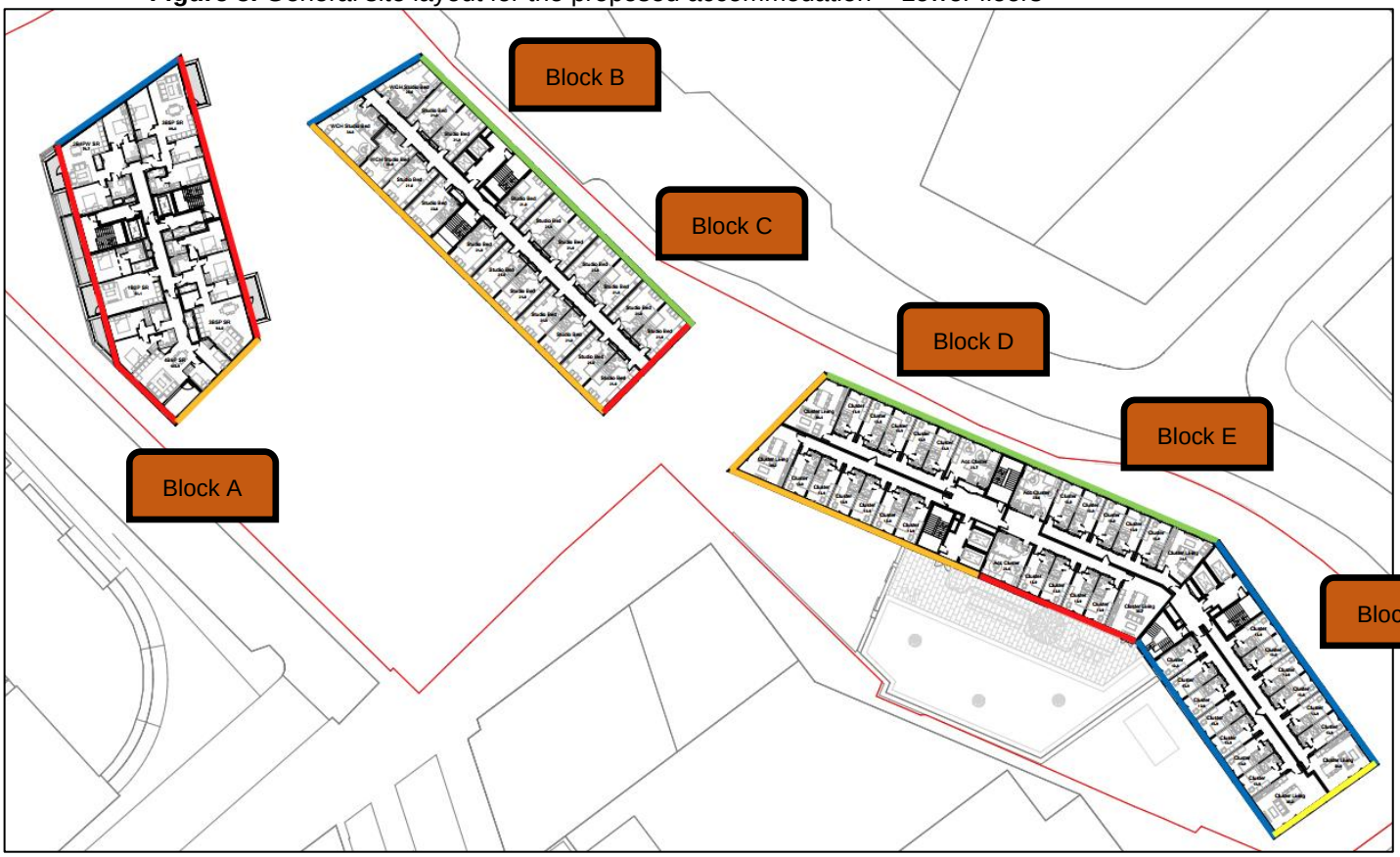


Figure 6. General site layout for the proposed accommodation – Upper floors

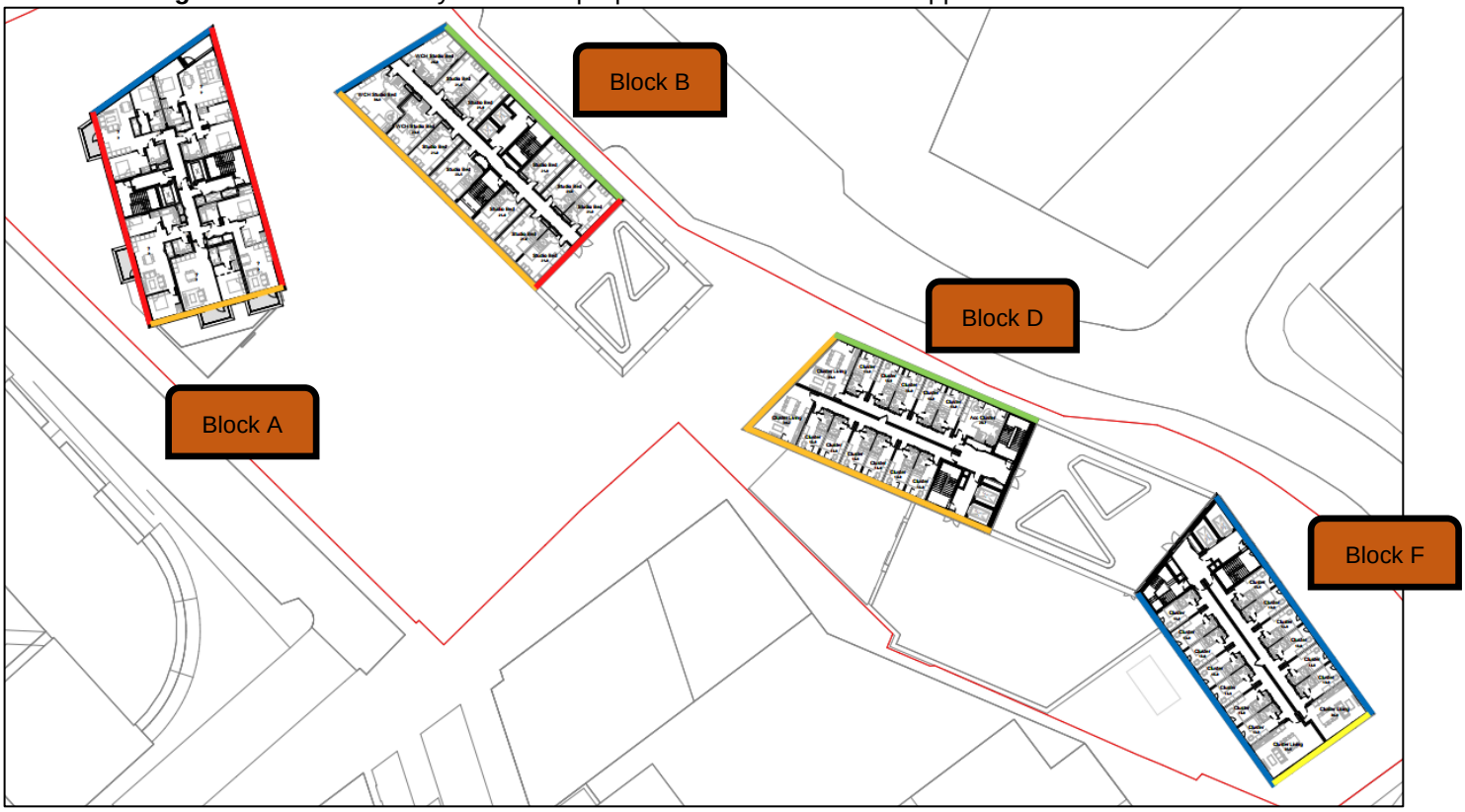


Table 13. Glazing Schedule

Colour	Floor	Room	Minimum Glazing Rating R_w dB	Internal Noise Level Target	Calculated Internal Noise Level	
				$L_{Aeq,T}$ dB Day/Night	$L_{Aeq,T}$ dB Day/Night	L_{Amax} Night
Orange	All	Studio	31	35/30	32/29	45
		Cluster			34/30	42
		Kitchen/Living		35/-	32/-	-
Green	GF - 06	Studio	40	35/30	31/28	45
		Cluster			31/28	45
	07 and above	Studio	35		31/28	39
		Cluster			33/29	41
Red	All	Apartments - Bed	35	35/30	32/29	41
		Studio			29/26	44
		Cluster			29/25	41
		Kitchen/ Living		35/-	30/-	-
Blue	Alll	Apartments - Bed	40	35/30	31/28	39
		Studio			32/29	42
		Cluster			32/28	41
		Kitchen/Living		35/-	32/-	-
Yellow	All	Kitchen/Living	45	35/-	33/-	-

With the glazing specifications proposed in Table 13 above, calculations suggest that the internal Day and Night time BS8233:2014/WHO noise level requirements can be achieved. Calculated internal noise levels are given on the worst-case internal receivers.

In addition to the above, calculations have been undertaken to determine L_{Amax} noise levels within the bedrooms at night time. Using the full night time L_{Amax} noise levels measured across site and previous rail measurements, with the glazing and ventilation specifications above, the calculated L_{Amax} values will not normally exceed 45 dB L_{Amax}.

6.1.1 Glazing Specification and Installation Notes

Notes on Glazing Installation

For the glazing specifications in Table 13, all sound insulation values quoted must be achieved by the overall combination of frame and glazing, and not just by the glazing alone. The frame should not reduce the performance of the system overall. Glazing framing systems must be fully sealed with any small gaps (<10mm nominal) around the perimeter to be stuffed with dense mineral wool to full frame depth and sealed both sides with acoustic non-setting mastic, with additional weathering protection to be applied additionally externally to this. No gaps should be left unsealed.

Minimum performance requirements for the combination of glazing and framing recommended in the above tables are as follows:

Table 14. Required Minimum Sound insulation of Combined Glazing and Framing

Typical Product	Minimum Sound Reduction Index R (dB) at Octave Band Centre Frequency (Hz)								R_w dB
	63	125	250	500	1k	2k	4k	8k	
4/12/4	16	22	19	25	36	42	36	35	**31**
6/12/8	23	23	21	33	40	37	48	48	**35**
8/12/8.8A	23	28	27	35	45	46	52	52	**40**
8.4A/16/10.4A	22	27	35	43	53	53	63	63	**45**

Figures stated in the table above are based on Saint Gobain manufacturer quoted data. Acoustic ratings should be checked with the manufacturer and supported by laboratory test reports where necessary. Any areas of aluminium panelling (if proposed) adjacent to the window glass should meet the same minimum specification as the glass to which they are adjacent.

6.2 Ventilation Requirements - Approved Document O (ADO), Method of Removing Heat

The new Building Regulations came into effect in June 2022 including for Approved Document O (ADO) which specifies internal noise limits for when windows will likely be required to be closed at night.

ADO provides a 10dB relaxation from the noise limits detailed within BS8233 with an internal limit of 40dB L_{Aeq} and 55dB L_{Amax}. However, open areas within the facade will dramatically compromise the acoustic performance. Based upon an open area of a louvre sized at 7.5% of the floor area we have calculated that this would attenuate the external noise level by 6 dB.

Our modelling results would suggest that the noise level across the different facades of the scheme would range between 50dB L_{Aeq} at the most shielded facades to 71dB L_{Aeq} for the most exposed facade. Applying the 6dB attenuation for the open louvre would result in an internal noise level that would range between 44dB – 65dB L_{Aeq}. Please note that similar exceedances are also noted for the L_{Amax} criteria. This would therefore indicate that all facades would exceed the requirements for an open window or open louvre.

Therefore in order to comply with the requirements of ADO, alternative means than an unattenuated opening within the façade would be required to control of overheating.

6.3 External Walls

It is assumed that the external wall construction will be brick with a structural metal frame inner leaf. Within our calculations it has been determined that the sound insulation performance of the façade should be greater than 64 dB R_w. Manufacturer's test data has been used based upon the example build-up below:

- 100mm facing brickwork. Inner leaf consists of minimum 10mm sheathing board (8kg/m^2 mass per unit area) on one side of a minimum 100mm Metsec frame/steel stud with a minimum 50mm mineral wool insulation (minimum 10kg/m^3 density) in the cavity and 2 no. layers of 12.5mm Wallboard plasterboard internal lining (total mass per unit area 16kg/m^2)

Please note that the external façade should have no unsealed penetrations, and any openings for ventilation should meet the specifications for ventilators above.

6.4 Roof

Within the calculations the roof has been assumed to be a concrete slab roof construction with insulation and plasterboard ceiling within the top floor rooms. It is considered that this is likely to be acceptable.

Insul sound prediction software would suggest the a typical minimum 150mm concrete slab structure has a laboratory sound insulation of at least 55 dB R_w, which is considered to be acceptable.

6.5 Ground Floor Spaces

It is proposed that there will be ancillary spaces on the ground floor of the building including Commercial, Laundry and Amenity areas. The required sound insulation performance of separating elements in residential buildings is governed by the Building Regulations Approved Document E, which sets out minimum sound reduction performance criteria that should be achieved between the spaces.

Clause 0.8 of Approved Document E would suggest that, '*the performance standards set out in Tables 1a and 1b (of the document) are appropriate for walls, floors and stairs that separate spaces used for normal domestic purposes. A higher standard of sound insulation may be required between spaces used for normal domestic purposes and communal or non-domestic purposes. In these situations the appropriate level of sound insulation will depend on the noise generated in the communal or non-domestic space. Specialist advice may be needed to establish if a higher standard of sound insulation is required and, if so, to determine the appropriate level.*'

Where the proposed use is to be low noise generation, e.g. offices, it is considered that meeting the minimum sound insulation criteria of Approved Document E for the separating walls/floors is likely to be sufficient. Where the use is likely to generate greater noise than that experienced in normal domestic uses then uprating works to the building structure may be required using enhanced ceilings or improved wall constructions/linings, etc. Assessment will be undertaken at detailed design stage to control internal noise levels to bedrooms to meet the requirements of BS8233:2014.

6.6 External Amenity Spaces

Using the 3-dimensional noise model created within SoundPLAN, as discussed within Section 5.0, noise level predictions have been made for the external amenity areas. These have been modelled as 1.5m from the ground in the public realm area and 1.0m off of the roof area for Level 7 terrace areas on Block B-C and Block D-F. For Level 1 Ground Floor terrace, the measurement data from ST1 has been used for calculation purposes. The noise levels in the amenity areas are as follows:

Table 16. Predicted Noise Levels in External Amenity Areas

Position	L_{Aeq} dB
Public Realm	55-73
Block D-F - Level 1 – Ground Floor Terrace	64
Block B-C – Level 7 – Terrace	58
Block D-F – Level 7 - Terrace	62

Within Section 3.3, it is discussed how an external noise level of 55dB L_{Aeq} is desirable in noisier environments as stated within BS8233:2014. However, it is also considered within the standard how:

'*In higher noise areas, such as city centers 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.'*

Therefore, we would consider that, given the location of development which is in a highly developed area of London surrounded by transportation links and industrial units, the predicted external amenity noise levels presented within table 16 may be warranted. It is understood that 2m high walls are surrounding the terraced areas and therefore enabling the amenity area to achieve the lowest practicable levels through design.

7.0 CONCLUSIONS

PDA Ltd was commissioned by Watkin Jones to carry out an environmental noise and vibration assessment report for the proposed new build student and residential accommodation development at Battersea Park Road, London. This report is in support of the application for Phased Full Planning Permission for: Demolition of existing building and construction of three new buildings, together comprising Residential (Use Class C3) and Student Accommodation (Sui Generis) along with Commercial, Business and Service (Use Class E) and/or Local Community and Learning (Class F) floorspace. Associated works include hard and soft landscaping, car parking and new vehicular access / servicing, and other ancillary works.

The proposed development consists of 3 no. 12-22 storey blocks consisting of 762 no. student bedrooms along with 55 no. residential units, all with ancillary management facilities.

Noise level surveys were undertaken at the site representative of daytime hours as well as a full night time. The local noise climate is dominated by road traffic noise from Battersea Park Road (A3205) and to a lesser extent 'A-road' throughout the day and night time. Contributions from surrounding local roads include cars, buses, lorries and motorbikes. Rail noise dominates the south of the site with regular pass-bys throughout the day and lesser in the night.

Based upon the measured and predicted noise levels, supplemented with previous railway noise data, calculations have been undertaken for the Bedrooms and Living Spaces to evaluate the internal noise levels. Recommendations are given for glazing, ventilation and building façade elements to meet the internal noise level requirements of good practice guidance given in BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings. Calculations suggest that the noise level criteria of BS8233:2014 can be achieved within the proposed accommodation. Calculations have also been carried out to assess the external amenity spaces where it is noted that, a compromise in noise level is warranted when living in a highly developed urban area and therefore considered acceptable in the context of BS8233:2014. In addition, an assessment has been carried out in regards to Approved Document O, which concludes that an alternative means of ventilation is required rather than relying on open windows during the night-time periods.

In addition a vibration survey has been undertaken running concurrently with the noise measurements. The measured and predicted vibration levels are well below the '*Low probability of adverse comment*' criterion of BS 6472 for both day and night time periods and as such, BS 6472 would suggest that for levels below the ranges, adverse comment is not expected.

APPENDIX A – NOTES FOR QUALITY CONTROL

1. Blockwork

All blockwork is to be mortared to an almost fair faced standard both horizontally and vertically. Only perfect blocks may be used with no pitting or cracks. The blockwork must seal effectively to the underside of the soffit.

Where blockwork walls form a cavity wall, care should be taken to avoid rubble and snots from bridging the cavity. This is especially important where one or more of the leaves is floating.

2. Plasterboard

All plasterboard joints are to be butted tight. The rule of thumb is that the joint should be tight enough over its entire length to prevent a normal business card from being inserted. Multiple layers should be fitted with staggered joints.

Base details and deflection heads are to be as per the British Gypsum White Book unless otherwise stated, and copious amounts of mastic to be used when fitting to the walls, floor and ceiling respectively.

3. Mineral Fibre

Mineral fibre slabs are to be butted tightly together and to boundary structures, to form a homogeneous layer.

4. Windows

All window frames are to be a good tight fit into the building structure with any gaps to be filled both internally and externally with a non-setting mastic in addition to the usual weather proofing seal to the exterior. Any gaps between the frame and building that are greater than 5 mm are to packed with a dense mineral fibre prior to mastic sealing.

5. Electrical Sockets

Electrical sockets must not be fitted back to back and removed areas of blockwork and plasterboard should be kept to an absolute minimum.

6. Water Pipes

All water pipes (and any other pipework) are to be resiliently mounted to avoid “water hammer”. This is particularly important for plasterboard walls.

7. Penetrations

Penetrations are to be dealt with as described in this report. Details for specific services penetrations may be supplied upon request.

8. Approved Samples and Inspections

Samples of each individual acoustic element should be provided for inspection at the beginning of its installation. Once approved, the Clerk of Works must ensure that the same level of quality continues throughout construction.

APPENDIX B – DEFINITION OF ACOUSTIC TERMS

The decibel

This is the basic unit of noise, denoted dB.

A Weighting

This is a weighting process which simulates the human ear's different sensitivity at different frequencies. A weighting can be shown two typical ways, 50 dB(A) L_{eq} or 50 dB $L_{Aeq.}$ Both mean the same thing. (See below for a definition of L_{eq}). The dB(A) level can be regarded as the overall level perceived by human beings.

L_{eq} and $L_{eq(s)}$

This is the equivalent continuous noise level which contains the same acoustic energy as the actual time-varying sound. In other words it is a kind of average noise level. It is denoted dB L_{eq} or, for A-weighted figures dB(A) L_{eq} or dB L_{Aeq}. It can also be expressed in terms of frequency analysis (see later). $L_{eq(s)}$ is the sample L_{eq} level.

L_n

This is the level exceeded for n% of the time. It is denoted dB L_n or, for A-weighted figures dB(A) L_n or dB $L_{An.}$ It can be expressed in terms of frequency analysis (see later). L_{90} is the level exceeded for 90% of the time and is a measure of the lowest level typically reached. L_{10} is the level exceeded for 10% of the time and is the highest level typically reached. L_{50} is the level exceeded for 50% of the time and, mathematically, it is the median.

L_{max}

This is the maximum level reached during a measurement period. The "time constant", or the ability of the equipment to respond to impulses is usually expressed along with it, e.g. "Fast", "Slow", etc. It is denoted dB L_{max} or, for A-weighted figures dB(A) $L_{max,}$ dB $L_{Amax,}$ etc. It can also be expressed in terms of frequency analysis.

Frequency Analysis

Whereas dB(A) gives a very useful overall figure, it has its limitations in that it cannot be used to model or predict the effect of noise control and mitigation as this nearly always has radically different performance at different frequencies.

Frequency analysis expresses an overall noise level at each frequency or band of frequencies in the audible range. Octave band analysis divides the audible range into 10 bands from 31.5 Hz to 16 kHz and the noise level in each band can be expressed in any form e.g. L_{eq}, L_{90}, L_{max} etc. One third octave band analysis uses 30 bands.

Narrow band analysis takes the process to resolutions of less than 1 Hz. This is useful for identifying the existence of tones (whines, hums, etc.) and in pin-pointing the sources.