

ENVIRONMENTAL NOISE ASSESSMENT

115 Chatham Street, Reading

Produced by XCO₂ for Archel Homes Limited.

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CONTENTS

EXECUTIVE SUMMARY 5

INTRODUCTION 6

PLANNING POLICIES.....7

DESIGN NOISE LEVELS.....13

MEASUREMENT OF NOISE LEVELS 18

ASSESSMENT OF ENVIRONMENTAL NOISE IMPACTS 24

CONCLUSION..... 29

APPENDIX A 30

APPENDIX B 31

APPENDIX C 37

ENVIRONMENTAL NOISE ASSESSMENT

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EXECUTIVE SUMMARY

It is proposed to redevelop the site at 115 Chatham Street, Reading, for residential use. 54 new homes are to be provided in a new five-storey building (ground and first to fourth floors).

An assessment is required of the acoustic suitability of the site for residential use, including outline acoustic specifications for the external building fabric.

ENVIRONMENTAL NOISE ASSESSMENT

In order to reduce intrusive noise to acceptable levels inside the flats, glazing with an enhanced performance is required to all windows overlooking Chatham Street and the service area at the north of Face Bar, to the south west of the site. The required performance is given in Table 12 and Table 13 in the body of this report; the façades where enhanced glazing is required are shown in BLUE and RED in Appendix C. To control night-time traffic noise to acceptable levels, MVHR systems are required to bedrooms on the north (Chatham Street) elevation. High performance acoustic ventilators are recommended for rooms on the south west corner of the site (BLUE façades) to mitigate against potential noise from Face Bar.

INTRODUCTION

It is proposed to redevelop the site at 115 Chatham Street, Reading, for residential use. A new five storey building (ground and first to fourth floors) will be constructed, to incorporate 54 new dwellings.

SITE LOCATION

The site is located on the south side of Chatham Street, Reading, to the east of its junction with Ambrose Place (See Figure 1 below).

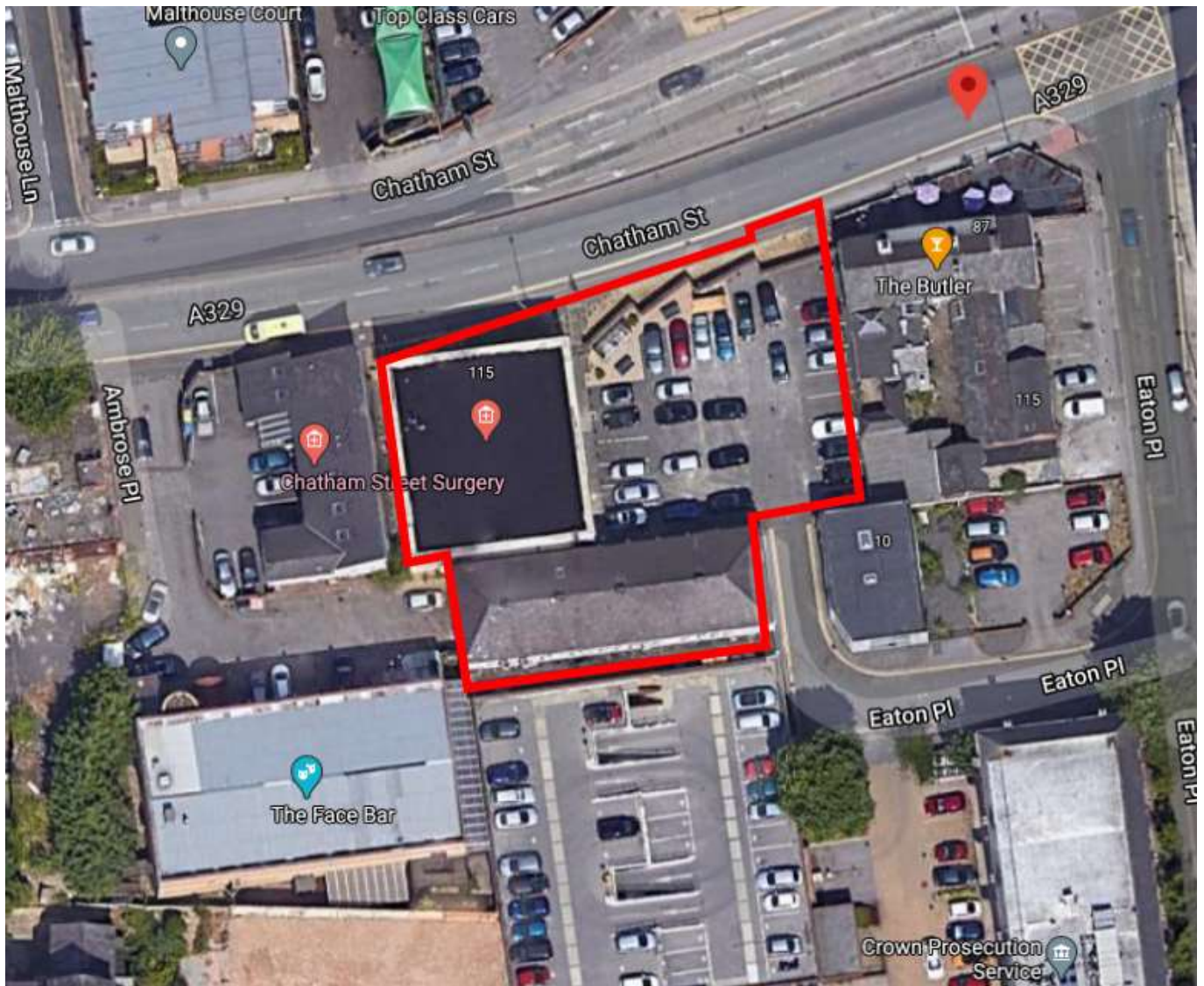


Figure 1: Site location images.

PLANNING POLICIES

A great deal of change has occurred in recent years in the assessment of noise impacts and their relationship with planning decisions. The following sections introduce the applicable policies, either national or local, which ought to be considered to support the planning application. It should be highlighted that the assessment is mainly addressed to the local planning authority.

NOISE POLICY STATEMENT FOR ENGLAND

The Noise Policy Statement for England (NPSE¹), published in March 2010, sets out the long-term vision of Government noise policy. The Noise Policy aims, as presented in this document, are: *“Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*

- *avoid significant adverse effects on health and quality of life;*
- *mitigate and minimise adverse effects on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life.”*

The NPSE makes reference to the concepts of NOEL (No Observed Effect Level) and LOAEL (Lowest Observed Adverse Effect Level) as used in toxicology but applied to noise impacts. It also introduces the concept of SOAEL (Significant Observed Adverse Effect Level) which is described as the level above which significant adverse effects on health and quality of life occur.

The first aim of the NPSE is to avoid significant adverse effects, taking into account the guiding principles of sustainable development (as referenced in Section 1.8 of the NPSE). The second aim seeks to provide guidance on the situation that exists when the potential noise impact falls between the LOAEL and the SOAEL, in which case: *“...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.”*

Importantly, the NPSE goes on to state that: *“This does not mean that such adverse effects cannot occur.”*

The NPSE does not provide a noise-based measure to define SOAEL, acknowledging that the SOAEL is likely to vary depending on the noise source, the receptor and the time in question. NPSE advises that: *“Not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.”*

It is therefore likely that other guidance will need to be referenced when applying objective standards for the assessment of noise, particularly in reference to the SOAEL, whilst also taking into account the specific circumstances of a proposed development.

¹ Noise Policy Statement for England, Defra, March 2010

NATIONAL PLANNING POLICY FRAMEWORK

A new edition of NPPF was published in February 2019 and came into effect immediately. The original National Planning Policy Framework (NPPF²) was published in March 2012, with a revision in July 2018 - this document replaced the existing Planning Policy Guidance Note 24 (PPG 24) "Planning and Noise." The 2019 revised edition contains no new directions or guidance with respect to noise, and hence, all previous references remain extant. The paragraph references quoted below relate to the February 2019 edition.

Paragraph 170 of the NPPF states that the planning system should contribute to and enhance the natural and local environment by, (amongst others) *"preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, water or noise pollution or land stability."*

The NPPF goes on to state in Paragraph 180 *"planning policies and decisions 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 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 ...*

The NPPF document does not refer to any other documents or British Standards regarding noise other than the NPSE.

Paragraph 2 of the NPPF states that *"planning law requires that applications for planning permission must be determined in accordance with the development plan unless material considerations indicate otherwise."*

Paragraph 12 of the NPPF states that "The presumption in favour of sustainable development does not change the statutory status of the development plan as the starting point for decision making. Where a planning application conflicts with an up-to-date development plan (including any neighbourhood plans that form part of the development plan), permission should not usually be granted. Local planning authorities may take decisions that depart from an up-to-date development plan, but only if material considerations in a particular case indicate that the plan should not be followed "

Paragraph 117 states that *"Planning policies and decisions should promote an effective use of land in meeting the need for homes and other uses, while safeguarding and improving the environment and ensuring safe and healthy living conditions. Strategic policies should set out a clear strategy for accommodating objectively assessed needs, in a way that makes as much use as possible of previously-developed or 'brownfield' land."*

² National Planning Policy Framework, DCLG, March 2012

PLANNING PRACTICE GUIDANCE – NOISE

An updated Planning Practice Guidance (PPG³) for noise was published on 22 July 2019 and provides additional guidance and elaboration on the NPPF. It advises that when plan-making and decision-taking, the Local Planning Authority should consider the acoustic environment in relation to:

- Whether or not a significant adverse effect is occurring or likely to occur;
- Whether or not an adverse effect is occurring or likely to occur; and
- Whether or not a good standard of amenity can be achieved.

This guidance introduced the concepts of NOAEL (No Observed Adverse Effect Level), and UAEL (Unacceptable Adverse Effect Level). NOAEL differs from NOEL in that it represents a situation where the acoustic character of an area can be slightly affected (but not such that there is a perceived change in the quality of life). UAEL represents a situation where noise is ‘very disruptive’ and should be ‘prevented’ (as opposed to SOAEL, which represents a situation where noise is ‘disruptive’, and should be ‘avoided’).

As exposure increases above the LOAEL, the noise begins to have an adverse effect and consideration needs to be given to mitigating and minimising those effects, taking account of the economic and social benefits being derived from the activity causing the noise. As the noise exposure increases, it will then at some point cross the SOAEL boundary.

The LOAEL is described in PPG⁴ as the level above which “noise starts to cause small changes in behaviour and attitude, for example, having to turn up the volume on the television or needing to speak more loudly to be heard”.

PPG identifies the SOAEL as the level above which “noise causes a material change in behaviour such as keeping windows closed for most of the time or avoiding certain activities during periods when the noise is present.”

In line with the Explanatory Note of the NPSE, the PPG goes on to reference the LOAEL and SOAEL in relation to noise impact. It also provides examples of outcomes that could be expected for a given perception level of noise, plus actions that may be required to bring about a desired outcome. However, in line with the NPSE, no objective noise levels are provided for LOAEL or SOAEL although the PPG⁵ acknowledges that “...the subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation.”

The relevant guidance in the PPG in relation to the adverse effect levels is summarized in Table 1.

³ Planning Practice Guidance – Noise, <https://www.gov.uk/guidance/noise--2>, 22 July 2019

⁴ Paragraph: 005 Reference ID: 30-005-20190722

⁵ Paragraph: 006 Reference ID: 30-006-20190722

Table 1. PPG guidance on adverse effect levels.

Perception	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 perceived 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

The Planning Practice Guidance⁶ states the following in relation to mitigation measures:

“For noise sensitive developments, mitigation measures can include avoiding noisy locations in the first place; designing the development to reduce the impact of noise from adjoining activities or the local environment; incorporating noise barriers; and optimising the sound insulation provided by the building envelope.”

⁶ Paragraph: 010 Reference ID: 30-010-20190722

In addition, the Guide notes that it may also be relevant to consider⁷:

“... whether any adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time (and the effect this may have on living conditions). In both cases a suitable alternative means of ventilation is likely to be necessary. Further information on ventilation can be found in the Building Regulations”.

BRITISH STANDARD 8233: 2014

This report has been commissioned to recommend measures to be taken so as to ensure that reasonable standards of peace and quiet are achieved within the dwellings when constructed.

This has been achieved by measuring the existing sound levels on the site and then considering the amount of sound insulation required of the building envelope so as to ensure that target noise levels within the residential flats are achieved. This is based on the guidance set out within BS 8233: 2014 “British Standard Code of practice for Sound insulation and noise reduction for buildings”, which states that:

This British Standard provides guidance for the control of noise in and around buildings. It is applicable to the design of new buildings, or refurbished buildings undergoing a change of use, but does not provide guidance on assessing the effects of changes in the external noise levels to occupants of an existing building.

This British Standard does not cover:

- a) Specialist applications, such as auditoria and cinemas (for cinemas, see BS ISO 9568);*
- b) Vibration control, except where it is evident in the form of radiate sound; or*
- c) Noise that breaks out from the building that might affect external receptors.*

LOCAL PLAN POLICY

Reading Borough Council's new local plan was adopted in November 2019.

Policy CC8 *Safeguarding Amenity* states:

Development will not cause a detrimental impact on the living environment of existing residential properties or unacceptable living conditions for new residential properties, in terms of:

...
□ Noise and disturbance;

...

Where an otherwise acceptable development could change its character to a use that would have a greater impact on amenity without needing planning permission, conditions will be applied to restrict such changes

Policy EN16 Pollution and water resources states:

⁷ Paragraph: 006 Reference ID: 30-006-20190722

ENVIRONMENTAL NOISE ASSESSMENT

Development will only be permitted where it would not be damaging to the environment and sensitive receptors through land, noise or light pollution; where it would result in no deterioration in, or ideally enhance, ground and surface water quality; and where adequate water resources, sewerage and wastewater treatment infrastructure will be in place to support the proposed development prior to occupation.

Proposals for development that are sensitive to the effects of noise or light pollution will only be permitted in areas where they will not be subject to high levels of such pollution, unless adequate mitigation measures are provided to minimise the impact of such pollution.

As no specific noise criteria is included within the policies, it is appropriate to draw on recognised Standards and Guidance.

DESIGN NOISE LEVELS

INSTITUTE OF ACOUSTICS PROFESSIONAL PRACTICE GUIDANCE

The Institute of Acoustics published a guidance document for new residential development in May 2017, in conjunction with the ANC and the Chartered Institute of Environmental Health, “*to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England*”. While this guidance is specifically for new residential developments it is generally used to inform designs for hotels and similar accommodation which are sensitive to intrusive noise in the same way as dwellings.

The document advocates a two-stage process for consideration of noise affecting new residential developments. Stage 1 is an initial risk assessment of the proposed development site, based on the ambient noise levels in the area. Stage 2 recommends consideration of four main elements:

- demonstration of a “good acoustic design process”
- observation of internal noise guidelines
- an assessment of noise affecting external amenity areas
- consideration of other relevant issues

The initial risk assessment considers the indicative day-time and night-time equivalent continuous noise levels which indicates an “increasing risk of adverse effect” with increasing noise levels⁸.

For Stage 2, the ProPG document recommends that the guidance in BS 8233:2014 is followed.

Noise control in and around buildings is discussed in the British Standard guides on an objective and quantifiable basis. The guides suggest criteria, such as suitable sleeping/resting conditions, and propose noise levels that normally satisfy these criteria for most people.

BS 8233:2014 GUIDANCE ON SOUND INSULATION AND NOISE REDUCTION FOR BUILDINGS.

This Standard provides recommended guideline values for internal noise levels within dwellings which are similar in scope to guideline values contained within the World Health Organisation (WHO) document, Guidelines for Community Noise (1999⁹). These guideline noise levels are shown in Table 2, below:

Table 2. BS 8233 Desirable Internal Ambient Noise Levels for Dwellings.

Activity	Location	07:00 to 23:00 hours	23:00 to 07:00 hours
Resting	Living room	35 dB L _{Aeq,16h}	-
Dining	Dining room/area	40 dB L _{Aeq,16h}	-
Sleeping (daytime resting)	Bedroom	35 dB L _{Aeq,16h}	30 dB L _{Aeq,8h}

⁸ Figure 1, IoA ProPG for New Residential Development, May 2017

⁹ World Health Organisation Guidelines for Community Noise, 1999

BS 8233:2014 advises that: “regular individual noise events...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.” The assessment of individual noise events during the night-time may only be considered necessary for intermittent environmental sources such as aircraft or train pass-bys for which there is research available to assist with the quantification of the impact.

The standard also provides advice in relation to design criteria for external noise. It states that:

“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.

Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate.

Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation.

In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space.”

WORLD HEALTH ORGANISATION, GUIDELINES FOR COMMUNITY NOISE, 1999 (WHO)

The World Health Organisation (WHO) Guidelines for Community Noise (1999) recommends suitable internal and external noise levels based on dose response research. The levels recommended in this guidance could be correlated to the LOAEL. Relevant guidance from this document is presented below:

SLEEP DISTURBANCE (NIGHT-TIME INTERNAL LOAEL)

If negative effects on sleep are to be avoided, the equivalent sound pressure level should not exceed 30 dBA indoors for continuous noise.

INTERFERENCE WITH COMMUNICATION (DAYTIME INTERNAL LOAEL)

Noise tends to interfere with auditory communication, in which speech is a most important signal. However, it is also vital to be able to hear alarming and informative signals such as door bells, telephone signals, alarm clocks, fire alarms etc., as well as sounds and signals involved in occupational tasks. The effects of noise on speech discrimination have been studied extensively and deal with this problem in lexical terms (mostly words but also sentences). For

communication distances beyond a few metres, speech interference starts at sound pressure levels below 50 dB for octave bands centred on the main speech frequencies at 500, 1,000 and 2,000 Hz. It is usually possible to express the relationship between noise levels and speech intelligibility in a single diagram, based on the following assumptions and empirical observations, and for speaker-to-listener distance of about 1 metre:

- *Speech in relaxed conversation is 100% intelligible in background noise levels of about 35 dBA, and can be understood fairly well in background levels of 45 dBA.*
- *Speech with more vocal effort can be understood when the background sound pressure level is about 65 dBA.*

ANNOYANCE RESPONSES (DAYTIME EXTERNAL LOAEL FOR PRIVATE AMENITY AREAS)

During the daytime, few people are seriously annoyed by activities with L_{Aeq} levels below 55 dB; or moderately annoyed with L_{Aeq} levels below 50 dB.

THE NOISE INSULATION REGULATIONS 1975

The Noise Insulation Regulations 1975 define the conditions under which dwellings are eligible for noise insulation to control internal noise levels. The conditions relate to the level of traffic noise at the façade, the increase in noise levels as a result of the highway and the contribution of the new or altered scheme to the noise level received at the façade.

Noise insulation qualification criteria must abide by a few tests which include the following two:

- The facade noise threshold of 68dB $L_{A10, 18h}$ is met or exceeded;
- That there must be a noise increase of at least 1dB(A) compared to the prevailing noise level immediately before the construction of a highway or an additional carriageway were begun;

SOAELS FOR TRANSPORTATION AIRBORNE NOISE

Based on the noise insulation regulations a façade noise level of 69dB $L_{A10, 18h}$ is therefore considered as unacceptable and can trigger the provision of mitigation measures by the government. This level can therefore be used as the SOAEL in relation to transportation noise in England. This level relates to a level of 64 dB $L_{Aeq, 16h}$. Based on guidance¹⁰ in BS8233:2014, an external noise level of 64 dB $L_{Aeq, 16h}$ would roughly equate to an internal level of 49 dB $L_{Aeq, 16h}$, assuming partially open windows for ventilation. As daytime and night-time desirable target levels differ by 5 dB, a night-time SOAEL could be 44 dB $L_{Aeq, 8h}$. It should be noted that these internal SOAEL values may be deemed pessimistic since partially open windows for background ventilation do not offer compliance with the relevant building regulations.

¹⁰ BS8233:2014 states that "If partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB"

PROPOSED LOAEL AND SOAEL FOR TRANSPORTATION AIRBORNE NOISE AFFECTING ROOMS USED FOR RESIDENTIAL PURPOSES.

A summary of the proposed LOAEL and SOAEL values are provided in Table 3 below. It should be highlighted that the Secretary of State's approved assessment methodology for the HS2 project includes a SOAEL of 65 dB $L_{Aeq,16h}$. The HS2 project also includes a LOAEL of 50 dB $L_{Aeq,16h}$. Therefore, the difference between the LOAEL and SOAEL for transportation noise in the secretary of state's approved HS2's environmental statement is 15dB.

Table 3. Proposed LOAEL and SOAEL for transportation noise affecting dwellings.

Level	Daytime (07:00 hours to 23:00 hours)	Night-time (23:00 hours to 07:00 hours)
LOAEL Internal	35 $L_{Aeq,16h}$ (dB)	30 $L_{Aeq,8h}$ (dB)
SOAEL Internal	49 $L_{Aeq,16h}$ (dB)	44 $L_{Aeq,8h}$ (dB)
LOAEL External	50 $L_{Aeq,16h}$ (dB)	40 $L_{Aeq,8h}$ (dB)
SOAEL External	65 $L_{Aeq,16h}$ (dB)	55 $L_{Aeq,8h}$ (dB)

The LOAEL and SOAEL values above are related to the first two aims in Paragraph 123 of the NPPF.

BUILDING REGULATIONS

Part L of the Building Regulations mandates that buildings become more airtight, and Part F stipulates ventilation requirements. Even though there appears to be a contradiction in this, Part L limits uncontrollable ventilation, while Part F ensures that ventilation requirements are provided in a controlled manner.

VENTILATION REQUIREMENTS FOR HABITABLE ROOMS

Background ventilation

Three types of ventilation are required under Part F. Whole building ventilation provides nominally continuous air exchange which may be reduced or ceased when the building is not occupied. It can be provided via background ventilators operating alone, or together with:

- passive stack ventilators;
- continuous mechanical extract; or
- continuous mechanical supply and extract with heat recovery.

Extract ventilation is applicable to rooms where most water vapour and/or pollutants are released (e.g. kitchens and bathrooms). It can be provided by intermittent fans, passive stack or continuous mechanical extract with or without mechanical supply and heat recovery.

The four systems described in Part F do not present solutions which utilise the use of opening windows for background ventilation. Opening windows do not provide a controllable means of ventilation and also pose security risks. Therefore, it is not possible to offer to the market a residential dwelling which utilises opening windows for background ventilation.

Purge ventilation

Purge ventilation is required throughout the building to aid the removal of high concentrations of pollutants and water vapour. It is commonly provided simply by opening windows and doors.

Even though purge ventilation is recommended via opening windows, the temporary and intermittent occurrence of this does not normally result in an unacceptable increase of internal noise levels.

Part F goes on to say¹¹ that “*Purge ventilation provisions may also be used to improve thermal comfort, although this is not controlled under the Building Regulations.*”

SUMMARY IN RELATION TO VENTILATION

In summary, background ventilation for new residential dwellings should be provided via one of the four systems in Approved Document F. The composite external building fabric should be designed to ensure that appropriate internal noise levels due to external incident noise are met during background ventilation.

Purge ventilation for new residential dwellings should be provided via open windows. The slight increase of internal noise levels should be considered acceptable.

¹¹ Paragraph 4.15 in Approved Document F

MEASUREMENT OF NOISE LEVELS

The following section describes the methodology undertaken in order to establish the environmental noise levels around the site.

DETAILS OF ENVIRONMENTAL SOUND SURVEY

Continuous measurements of the incident sound pressure levels (at 2 locations) at the site were undertaken from 25th to 26th February 2021. The sound level meters were programmed to record the A-weighted L_{eq} , L_{90} , L_{10} and L_{max} noise indices and corresponding octave band frequency information (for L_{eq} and L_{max}) for consecutive sample periods for the duration of the survey.

MEASUREMENT POSITIONS

The measurements of incident sound levels were undertaken at two locations. No suitable secure locations were available within the site itself. The approximate locations of the sound level meters are indicated in the aerial photograph below and Table 4 describes the two measurement positions.

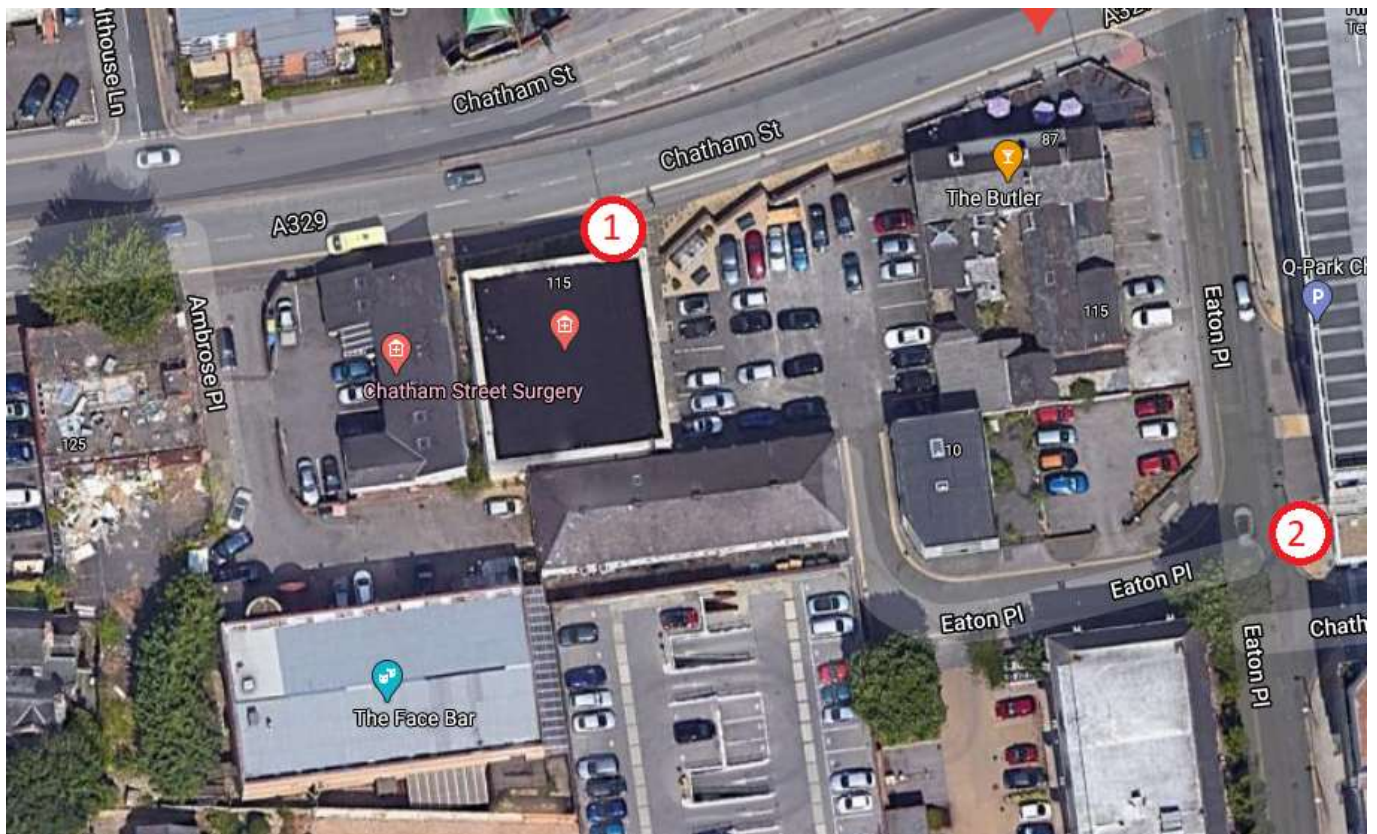


Figure 2: On site sound pressure level measurement positions.

Table 4. Description of measurement positions.

Position	Description
1	Lamp-post on Chatham Street
2	Lamp-post on Eaton Place

EQUIPMENT

Details of the equipment used during the survey are provided in Table 5 below. The sound level meters were calibrated before and after the survey; no significant change (± 0.2 dB) in the calibration level was noted.

Table 5. On site instrumentation.

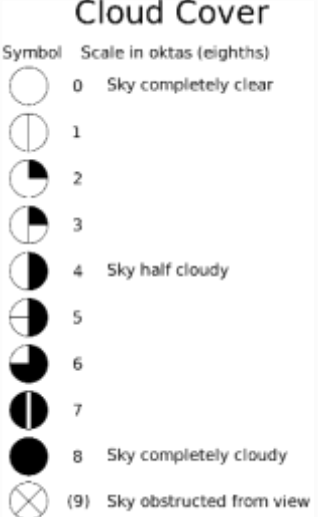
Position	Description	Model / serial no.	Calibration date	Calibration certificate no.
1	Class 1 Sound level meter	Svantek 977/ 69747	20/08/2020	14015672
	Condenser microphone	ACO Pacific 7052E / 70829		
	Preamplifier	Svantek SV12L / 73687		
	Calibrator	Svantek SV 40A / 10843	20/08/2020	14015672-3
2	Class 1 Sound level meter	Svantek 977/ 81301	31/10/2019	14013747-01
	Condenser microphone	ACO Pacific 7052E / 74660		
	Preamplifier	Svantek SV12L / 86561		
	Calibrator	Svantek SV 33B / 83850	23/10/2020	14016290

WEATHER CONDITIONS

Weather conditions were determined both at the start and on completion of the survey. It is considered that the meteorological conditions were appropriate for environmental noise measurements. Table 6 presents the weather conditions recorded on site at the beginning and end of the survey.

ENVIRONMENTAL NOISE ASSESSMENT

Table 6. Weather Conditions.

Date/Time	Description	Beginning of Survey	End of Survey
13.30 25 th February – 14.00 26 th February 2021	Temperature (°C)	7	11
 Cloud Cover Symbol Scale in oktas (eighths) 0 Sky completely clear 1 2 3 4 Sky half cloudy 5 6 7 8 Sky completely cloudy (9) Sky obstructed from view	Precipitation:	No	No
	Cloud cover (oktas - see guide)	8	0
	Presence of fog/snow/ice	No	No
	Presence of damp roads/wet ground	No	No
	Wind Speed (m/s)	<1	<1
	Wind Direction	-	-
	Conditions that may cause temperature inversion (i.e. calm nights with no cloud)	No	No

*no influence in the conclusions of the assessment.

RESULTS

Noise levels at both survey locations were dominated by road traffic. Construction noise was audible during removal of the meters.

EXTERIOR NOISE LEVELS

The single figure free field noise indices recorded are presented in tabular format within Appendix B. The relevant results of the survey have been summarised in Table 7.

Table 7. Summary of survey results (free field levels).

Position	Measurement period	Range of recorded sound pressure levels (dB)			
		L _{Amax, T}	L _{Aeq, T}	L _{A10, T}	L _{A90, T}
1 Chatham Street	Daytime (07.00 – 23.00 hours)	81 - 102	67 - 77	72 - 77	43 - 59
	Night-time (23.00 – 07.00 hours)	78 - 93	57 - 71	52 - 75	34 - 51
2 Eaton Place	Daytime (07.00 – 23.00 hours)	77 - 93	59 - 68	59 - 70	45 - 55
	Night-time (23.00 – 07.00 hours)	64 - 85	47 - 63	49 - 64	36 - 53

Table 8 below presents the incident free field noise levels at the measurement positions in terms of daytime and night-time levels measured during the monitoring period at the two locations.

Table 8. Daytime and night-time equivalent levels (free field levels).

Measurement Period		Free field sound pressure levels (dB)	
		Position 1	Position 2
25 th February (day)*	L _{Aeq, T}	71	64
25 th – 26 th February (night)	L _{Aeq} (8 hours)	66	57
26 th February (day)*	L _{Aeq} (16 hours)*	72	65
Overall – day	L_{Aeq, T}	72	64
Overall - night	L_{Aeq, T}	66	57

*not complete 16 hour measurements.

The incident octave band sound pressure levels at the noise monitors are shown in Table 9.

Table 9 Summary of measured free field environmental noise levels

Location/ façade	Period	Measured field sound pressure levels (dB) at Octave Band Centre Frequencies (Hz)								dB(A)
		63	125	250	500	1000	2000	4000	8000	
L1	Daytime L _{eq, 16 hours}	70	67	66	65	69	65	56	49	72
	Night-time L _{eq, 8 hours}	64	60	60	60	63	59	49	41	66
	Typical Night-time L _{Max}	91	84	82	84	79	75	67	61	84
L2	Daytime L _{eq, 16 hours}	67	62	60	59	62	56	49	42	64
	Night-time L _{eq, 8 hours}	60	55	53	52	55	49	40	33	57
	Typical Night-time L _{Max}	82	75	76	75	76	69	62	56	79

The night-time L_{max} data quoted are for the fifteen-minute period that includes the 15th-highest individual ($L_{Amax, 1 \text{ sec}}$) noise event and therefore offers a very robust assessment of traffic noise.

COVID-19

The environmental noise survey was undertaken in February 2021, at a time when the coronavirus pandemic was causing a disruption to working patterns and other activity. It is therefore likely that during the time of the survey traffic flows during the survey were lower than they would normally be.

The potentially reduced traffic flows may lead to a reduction in the ambient sound level ($L_{Aeq,T}$) due to road traffic. Government estimates¹² indicate that during weekdays in the period covered, UK-wide private vehicle use was approximately 60% of normal use, with light goods vehicles at approximately 80% of normal and heavy goods vehicles approximately as normal. A reduction of 60% in car numbers would suggest a reduction in noise level of around 2dB(A) from cars alone, on heavily-used roads where the flow of vehicles is continuous, for example close to motorways and other major trunk routes. The reduction in the overall traffic noise level, however, would be lower where there is a high proportion of goods vehicles, since reductions to 80% of the original traffic flow represent a noise reduction of around 1dB.

A review of noise mapping data for the area¹³ indicates that the usual ambient daytime noise level at the site is 65dB – 70dB $L_{Aeq,16\text{hour}}$ with night-time noise levels in the range 60 – 65dB $L_{Aeq,8\text{hour}}$. These levels are consistent with the values used in this assessment, indicating that no correction is required to take account of potentially reduced traffic flows during the survey period.

Maximum (L_{Amax}) sound levels are related to the noise level generated by individual vehicles, typically from acceleration, harsh braking and impacts on drain inspection covers, potholes etc. The measured L_{Amax} sound level at each sound level meter is therefore independent of the number of vehicles passing in a specific period and it is therefore reasonable to conclude that the typical highest maximum noise levels generated by vehicles has not been affected by the general reduction in traffic flows.

POTENTIAL NOISE FROM FACE BAR

Due to Covid-19 control measures, the venue was not trading during the noise survey. It is therefore necessary to predict likely worst-case noise levels from the venue.

From noise surveys undertaken (by others) for a site on Oxford Road¹⁴, to the south, music noise from Face Bar was found not to be audible at the survey location. It was noted, however, that the venue has no windows or doors on its south elevation and the entrance is on Ambrose Place, approximately 25m from the south west corner of the proposed building. The venue also has parking at the front and it may be assumed that this is used by taxis and customers arriving at and departing from the premises. Night-time L_{Amax} noise levels may therefore be similar to those on the northern elevation of the building, due to vehicles and people.

¹² <https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic>, retrieved 23 February 2021

¹³ <http://www.extrium.co.uk/noiseviewer.html>

¹⁴ Sharps Redmore report 1818348, Eaton Court, 104-112 Oxford Road, 15th November 2018

ENVIRONMENTAL NOISE ASSESSMENT

Assuming a reverberant sound level of 100dB L_{Aeq} within the venue, and a modest reduction of 30dB R_w for doors and windows, breakout noise levels at the proposed residential façade are likely to be no higher than 35-40 dB L_{Aeq} , and therefore significantly below the ambient noise levels due to road traffic. However, the noise is likely to include low frequency beats and would not be anonymous, and it is therefore appropriate to set the target noise criterion lower than would be acceptable for traffic noise; 10dB lower than the recommendations in BS 8233:2014 is considered to be an appropriate level; note that no similar correction factor is applicable to the night-time L_{Fmax} noise levels.

ASSESSMENT OF ENVIRONMENTAL NOISE IMPACTS

The following section presents the assessment of the various noise impacts in line with the methodology outlined in the preceding sections.

INCIDENT EXTERNAL SOUND LEVELS

Corrections for distance and, where appropriate, screening, angle of incidence and angle of view from the local noise sources have been made, to enable façade incident sound pressure levels to be calculated, as shown in Table 10. Façade identifications are shown in Appendix C. Corrections have also been made, where appropriate, for noise potential from the nearby commercial premises. These corrections are:

RED façade: -3dB correction to $L_{Aeq, 16hr}$ and $L_{Aeq, 8hr}$, and -6dB correction to L_{Amax} at measurement position 1, for increased distance from carriageway compared to the survey location

BLUE façade: -3dB correction to $L_{Aeq, 16hr}$ and $L_{Aeq, 8hr}$ at measurement position 2, for increased distance from carriageway compared to the survey location; -5dB correction to L_{Aeq} noise levels due to screening from traffic noise; -6dB correction to L_{Amax} at measurement position 1, for increased distance from carriageway compared to the survey location

GREEN façade: -3dB correction to $L_{Aeq, 16hr}$ and $L_{Aeq, 8hr}$, and -6dB correction to L_{Amax} at measurement position 2, for increased distance from carriageway compared to the survey location; -5dB correction to both L_{Aeq} and L_{Amax} noise levels due to screening from traffic noise.

Table 10. Façade sound levels used in assessment.

Façade		Sound pressure level (dB) at octave band centre frequency (Hz)								A
		63	125	250	500	1000	2000	4000	8000	
RED	Daytime $L_{eq, 16 \text{ hours}}$	67	64	63	62	66	62	53	46	69
	Night-time $L_{eq, 8 \text{ hours}}$	61	57	57	57	60	56	46	38	63
	Typical Night-time L_{Max}	85	78	76	78	73	69	61	55	78
BLUE	Daytime $L_{eq, 16 \text{ hours}}$	59	54	52	51	54	48	41	34	56
	Night-time $L_{eq, 8 \text{ hours}}$	52	47	45	44	47	41	32	25	49
	Typical Night-time L_{Max}	82	75	76	75	76	69	62	56	79
GREEN	Daytime $L_{eq, 16 \text{ hours}}$	59	54	52	51	54	48	41	34	56
	Night-time $L_{eq, 8 \text{ hours}}$	52	47	45	44	47	41	32	25	49
	Typical Night-time L_{Max}	71	64	65	64	65	58	51	45	68

INITIAL RISK ASSESSMENT

As noted in Table 10, the highest incident noise levels are 69 dB $L_{Aeq, 16hr}$ during the daytime and 63 dB $L_{Aeq, 8hr}$ at night.

The highest night-time noise levels are just within the “high” range of noise levels in Figure 1 of the IoA ProPG document, while the lowest noise levels are within the “low” range of values.

The ProPG document notes that “High noise levels indicate that there is an increased risk that development may be refused on noise grounds”. The ProPG document notes that even where noise levels are high “the risk may be reduced by following a “good acoustic design process” which “confirms how the adverse impacts of noise will be mitigated and minimised.”

It should be noted that there are existing residential properties alongside Chatham Street at Cherwell Court, so there is precedent for housing within this area.

ASSESSMENT OF REQUIRED GLAZING AND VENTILATION

In order to assess the site in relation to the applicable policy aims, it is important to review the internal noise levels due to incident noise ingress inside the proposed dwellings.

The composite acoustic performance required of any portion of the building envelope will depend on its location relative to the principal noise sources around the site and the nature of the spaces behind it (noise criteria, size, room finishes etc.).

Due to the layout, orientation, size, location and varying noise climate around the development it is implied that each façade and probably each window and ventilator (if present) on a facade should have a different sound insulation performance level in order for a specific internal ambient noise level to be reached. Logistically, this could result in increased costs for the development due to bespoke solutions, effects on programme and increase of errors during construction. National policy on noise does not insist on compliance with a specific level but rather it suggests that reasonable practicable mitigation measures should be put in place in order to approach a certain target level (assuming the non-mitigated impact is predicted to lie above this target level) when this level is below the SOAEL. Slight exceedances of this level are deemed acceptable under national policy on noise which supports sustainable development.

Therefore, it is not practical to specify a large number of different external building fabric constructions and this is also not supported by national policy on noise. It should be highlighted that, assuming there are no specific requirements for the acoustic performance of individual elements which make up the external building fabric, compliance with the building regulations would imply the use of double-glazed thermal glazing and trickle ventilators of the hit and miss type as a minimum (in relation to sound insulation). Therefore, compliance with the building regulations already implies a certain level of sound insulation from external noise which was not historically present (i.e. when partially open windows were considered an acceptable measure to provide background or primary ventilation into dwellings).

The detailed calculation methodology described in BS8233:2014 will be used in the assessment using the following equation¹⁵ as detailed in the British Standard:

$$L_{eq,2} = L_{eq,ff} + 10\log_{10} \left(\frac{A_0}{S} 10^{\frac{-D_{n,e}}{10}} + \frac{S_{w1}}{S} 10^{\frac{-R_{w,i}}{10}} + \frac{S_{ew}}{S} 10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S} 10^{\frac{-R_o}{10}} \right) + 10\log_{10} \left(\frac{S}{A} \right) + 3$$

Since full details of room and window layouts have not yet been developed, at this stage typical bedroom and living room dimensions and glazed areas have been used, based on information in drawings 022014-ARC-APT-P1 and 022014-ARC-APT-AP-E1. Table 11 presents the input data¹⁶ used to predict the resultant internal noise level in a bedroom and kitchen living dining room.

¹⁵ See page 65 and 66 of BS8233:2014 for an explanation of the various terms used in the equation.

¹⁶ Approximate values

ENVIRONMENTAL NOISE ASSESSMENT

Table 11. Room information required for the noise break in assessment.

Bedroom	
Room Volume (m ³)	33
Room Furnishings	Curtains, bed, timber floor finish
Area of window (m ²)	3
Area of wall (m ²)	10
Kitchen Living Dining rooms	
Room Volume (m ³)	81
Room Furnishings	Curtains, part-timber floor finish
Area of window (m ²)	5
Area of wall (m ²)	4

Different types of glazing will control noise to differing amounts and will vary according to the type of noise that should be reduced. The performance of glazing is established by measurement in the laboratory.

The glazing required to provide the internal noise levels recommended in BS 8233:2014 is shown in Table 12. For some elevations, passive ventilation, in the form of trickle ventilators, would be capable of controlling intrusive noise to meet the recommendations in BS 8233:2014. The minimum acoustic performance required is also shown in Table 12 and Table 13.

Table 12. Glazing and ventilation types.

Façade	Room type	Façade Specifications (See Table 13)	
		Glazing Type	Ventilator Type
RED	Living/Dining Rooms	Type B	Acoustic trickle vent (Ref 2)
	Bedrooms	Type B	MVHR
BLUE	Living/Dining Rooms	Type B	High performance acoustic trickle vent (Ref 3)
	Bedrooms	Type B	High performance acoustic trickle vent (Ref 3)
GREEN	Living/Dining Rooms	Type A	Non-acoustic trickle vent (Ref 1)
	Bedrooms	Type A	Non-acoustic trickle vent (Ref 1)

GLAZING AND VENTILATOR PERFORMANCE

Octave band performance required for the glazing and ventilation categories above are shown in Table 13. Performance requirements for windows must be met inclusive of frames, seals etc.

Table 13. Octave band performance specification for external building elements.

Item	Attenuation (dB) at Octave Band Centre Frequency (Hz)									
		63	125	250	500	1000	2000	4000	8000	$R_w + C_{tr}$
Type A Glazing [typically 4/16/4]	SRI	21	24	20	25	34	37	40	40	27
Type B Glazing [typically 10/16/6]	SRI	19	24	24	31	39	39	43	43	31
Ref 1) Standard trickle ventilator	D_{ne}	30	32	32	31	33	31	31	31	32
Ref 2) Acoustic trickle ventilator	D_{ne}	30	27	30	35	34	46	40	40	34
Ref 3) High performance acoustic trickle ventilator	D_{ne}	33	35	35	43	45	45	45	45	41
Non-vision wall – all areas Cavity brick-block construction (or cladding with dry-lining with similar acoustic performance)	SRI	35	41	45	45	54	58	55	55	48

These are minimum sound reduction indices and higher acoustic specifications could be used if required for other reasons.

Where MVHR systems or similar are required as above, or are required for other reasons (for example, to provide acceptable indoor air quality), the intake and exhaust ducts must incorporate appropriate attenuation to control intrusive noise (entering through fresh air and exhaust ducts) and noise generated by the fan(s) to no higher than 25 dB L_{Aeq} and no higher than 40dB L_{Amax} .

RESULTING INTERNAL NOISE LEVELS

The predicted internal sound pressure levels, based on the above are shown in Table 14.

Table 14: Internal sound levels (closed windows).

Façade	Room Type	Period	Sound pressure level, dB(A)			
			External façade level	Internal	BS 8233:2014 guidance	Excess
RED	Kitchen-living	Daytime $L_{eq, 16 \text{ hours}}$	69	33	35	-2
	Bedroom	Daytime $L_{eq, 16 \text{ hours}}$	69	30	35	-5
		Night-time $L_{eq, 8 \text{ hours}}$	63	24	30	-6
		Night-time L_{max}	79	43		
BLUE	Kitchen-living	Daytime $L_{eq, 16 \text{ hours}}$	56	19	25*	-6
	Bedroom	Daytime $L_{eq, 16 \text{ hours}}$	56	20	25*	-5
		Night-time $L_{eq, 8 \text{ hours}}$	49	13	20*	-7
		Night-time L_{max}	79	43		
GREEN	Kitchen-living	Daytime $L_{eq, 16 \text{ hours}}$	56	25	35	-10
	Bedroom	Daytime $L_{eq, 16 \text{ hours}}$	56	27	35	-8
		Night-time $L_{eq, 8 \text{ hours}}$	49	20	30	-10
		Night-time L_{max}	68	39		

*10dB reduction to allow for possible music noise from Face Bar

It should be noted that the assessment is based on the worst-case combination of window and room volume, and in other rooms of the same type on the façades noted intrusive noise levels will be lower than shown.

The assessment has shown that the resultant internal noise levels meet the guidance in BS 8233:2014 and therefore the second aim of the NPPF will be met in relation to internal amenity.

OUTDOOR LEVELS

Many of the proposed apartments will have access to small balconies at the rear (south elevation) of the building.

The external noise level at these balconies may be marginally (1 dB) above the upper guideline value (55 dB $L_{Aeq, 16 \text{ hours}}$) described in BS 8233:2014. However, BS8233:2014 does suggest that:

“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”.

CONCLUSION

Measurements of environmental noise at the proposed development site at 115 Chatham Street, Reading have been used to assess its suitability for residential development.

Outline recommendations for the acoustic performance requirements of the external building fabric have been assessed and noted.

ENVIRONMENTAL NOISE ASSESSMENT

In order to reduce intrusive noise to acceptable levels inside the flats, glazing with an enhanced performance is required to all windows overlooking Chatham Street and the service area at the north of Face Bar, to the south west of the site. The required performance is given in Table 12 and Table 13 in the body of this report; the façades where enhanced glazing is required are shown in BLUE and RED in Appendix C. To control night-time traffic noise to acceptable levels, MVHR systems are required to bedrooms on the north (Chatham Street) elevation. High performance acoustic ventilators are recommended for rooms on the south west corner of the site (BLUE façades) to mitigate against potential noise from Face Bar.

APPENDIX A

Table 15. Acoustic Terminology.

Parameter	Description
Ambient Noise Level	The totally encompassing sound in a given situation at a given time, usually composed of a sound from many sources both distant and near ($L_{Aeq,T}$).
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s_1 and s_2 is given by $20 \log_{10} (s_1/s_2)$. The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is $20\mu\text{Pa}$. The threshold of normal hearing is in the region of 0 dB and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.
dB(A), L_{Ax}	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 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).
Fast Time Weighting	Setting on sound level meter, denoted by a subscript F, that determines the speed at which the instrument responds to changes in the amplitude of any measured signal. The fast time weighting can lead to higher values than the slow time weighting when rapidly changing signals are measured. The average time constant for the fast response setting is 0.125 (1/8) seconds.
Free-field	Sound pressure level measured outside, far away from reflecting surfaces (except the ground), usually taken to mean at least 3.5 metres
Façade	Sound pressure level measured at a distance of 1 metre in front of a large sound reflecting object such as a building façade.
$L_{Aeq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level recorded during a noise event with a period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise. $L_{A10,18h}$ is the A-weighted arithmetic average of the 18 hourly $L_{A10,1h}$ values from 06:00-24:00.
$L_{90,T}$	A noise level index. The noise level that is exceeded for 90% of the measurement time interval, T. It gives an indication of the lower levels of fluctuating noise. It is often used to describe the background noise level and can be considered to be the "average minimum" noise level and is a term used to describe the level to which non-specific noise falls during quiet spells, when there is lull in passing traffic for example.

APPENDIX B

Table 16. Results of environmental noise measurements at Position 1.

Date & time	L _{AF,max} [dB]	L _{Aeq} [dB]	L _{A10} [dB]	L _{A90} [dB]
25/02/2021 13:30	71.6	89.0	75.2	58.9
25/02/2021 13:45	71.1	87.8	74.7	56.2
25/02/2021 14:00	71.6	84.2	75.3	56.0
25/02/2021 14:15	70.7	83.4	74.9	56.3
25/02/2021 14:30	71.7	94.0	75.3	57.3
25/02/2021 14:45	72.5	97.9	75.0	54.5
25/02/2021 15:00	71.3	86.8	75.3	58.9
25/02/2021 15:15	74.6	98.2	75.4	57.5
25/02/2021 15:30	71.5	88.5	75.4	57.0
25/02/2021 15:45	71.5	85.6	75.4	56.2
25/02/2021 16:00	72.0	88.0	75.9	55.2
25/02/2021 16:15	71.4	84.8	75.6	57.6
25/02/2021 16:30	71.7	89.3	75.7	56.4
25/02/2021 16:45	71.9	87.1	75.8	55.6
25/02/2021 17:00	72.6	92.6	75.9	57.8
25/02/2021 17:15	71.4	86.0	75.4	53.1
25/02/2021 17:30	73.4	95.9	76.2	56.9
25/02/2021 17:45	71.6	90.2	75.2	55.4
25/02/2021 18:00	72.6	90.5	76.1	55.9
25/02/2021 18:15	73.3	99.4	75.1	55.0
25/02/2021 18:30	71.5	87.8	75.2	51.3
25/02/2021 18:45	71.0	88.4	74.8	54.2
25/02/2021 19:00	70.9	85.8	75.1	55.3
25/02/2021 19:15	71.1	92.2	74.8	54.2
25/02/2021 19:30	70.7	84.2	74.7	53.1
25/02/2021 19:45	71.1	87.0	75.1	56.7
25/02/2021 20:00	70.6	85.7	74.8	54.3
25/02/2021 20:15	69.7	88.4	74.0	52.7
25/02/2021 20:30	69.9	84.3	74.4	52.1
25/02/2021 20:45	69.6	87.1	73.4	50.6
25/02/2021 21:00	69.7	85.0	74.1	51.5
25/02/2021 21:15	68.9	83.4	73.8	49.6
25/02/2021 21:30	68.5	81.5	73.2	46.8

ENVIRONMENTAL NOISE ASSESSMENT

Date & time	L _{AF,max} [dB]	L _{Aeq} [dB]	L _{A10} [dB]	L _{A90} [dB]
25/02/2021 21:45	68.2	80.9	73.0	48.0
25/02/2021 22:00	69.6	88.6	73.9	45.4
25/02/2021 22:15	68.7	84.3	73.2	46.7
25/02/2021 22:30	67.3	83.6	71.5	44.0
25/02/2021 22:45	67.1	84.0	71.7	43.3
25/02/2021 23:00	67.0	82.6	71.0	42.0
25/02/2021 23:15	65.4	83.4	69.1	39.5
25/02/2021 23:30	65.8	84.8	69.6	38.4
25/02/2021 23:45	64.2	82.5	67.7	38.5
25/02/2021 00:00	64.7	85.0	67.0	41.5
26/02/2021 00:15	63.3	81.6	66.9	37.3
26/02/2021 00:30	63.8	80.7	66.9	37.4
26/02/2021 00:45	63.7	79.7	66.3	38.9
26/02/2021 01:00	63.0	80.3	65.3	35.7
26/02/2021 01:15	63.9	85.4	65.6	35.5
26/02/2021 01:30	58.4	82.0	52.4	33.8
26/02/2021 01:45	61.6	83.4	61.6	36.3
26/02/2021 02:00	58.2	78.7	58.0	35.1
26/02/2021 02:15	60.9	80.0	62.9	35.4
26/02/2021 02:30	61.5	82.1	64.4	35.5
26/02/2021 02:45	61.1	80.7	62.2	36.6
26/02/2021 03:00	57.3	77.6	53.3	36.8
26/02/2021 03:15	59.6	80.5	61.1	38.0
26/02/2021 03:30	60.5	83.5	57.5	36.6
26/02/2021 03:45	60.8	80.0	64.5	38.1
26/02/2021 04:00	62.4	82.6	62.0	37.9
26/02/2021 04:15	63.0	81.5	66.1	39.9
26/02/2021 04:30	62.9	81.5	66.3	39.4
26/02/2021 04:45	64.2	82.1	68.3	40.3
26/02/2021 05:00	65.1	83.3	68.5	40.6
26/02/2021 05:15	65.4	81.7	69.3	43.0
26/02/2021 05:30	67.6	85.1	71.5	43.7
26/02/2021 05:45	69.3	85.0	73.6	46.2
26/02/2021 06:00	70.2	93.3	74.2	48.6
26/02/2021 06:15	70.5	91.4	73.9	50.6
26/02/2021 06:30	70.0	87.3	73.9	48.7

ENVIRONMENTAL NOISE ASSESSMENT

Date & time	L _{AF,max} [dB]	L _{Aeq} [dB]	L _{A10} [dB]	L _{A90} [dB]
26/02/2021 06:45	70.7	87.8	74.8	50.5
26/02/2021 07:00	71.6	86.6	75.6	53.3
26/02/2021 07:15	73.0	89.1	76.7	54.8
26/02/2021 07:30	72.5	84.4	76.7	58.4
26/02/2021 07:45	72.6	87.3	76.5	57.2
26/02/2021 08:00	73.1	85.4	77.0	59.0
26/02/2021 08:15	71.8	84.3	76.0	55.1
26/02/2021 08:30	72.0	89.2	75.7	56.0
26/02/2021 08:45	71.7	88.9	75.5	57.1
26/02/2021 09:00	71.3	84.3	75.7	54.5
26/02/2021 09:15	71.0	84.9	75.3	55.7
26/02/2021 09:30	70.6	82.2	74.9	56.2
26/02/2021 09:45	70.7	84.7	74.8	55.6
26/02/2021 10:00	70.5	82.4	74.9	55.3
26/02/2021 10:15	71.4	85.8	75.5	56.1
26/02/2021 10:30	72.1	97.0	75.5	57.1
26/02/2021 10:45	71.5	86.5	75.2	54.7
26/02/2021 11:00	70.7	84.7	74.9	56.1
26/02/2021 11:15	71.4	88.2	75.5	53.2
26/02/2021 11:30	71.5	85.7	75.6	56.1
26/02/2021 11:45	77.4	102.0	76.5	57.6
26/02/2021 12:00	71.0	85.4	74.8	54.6
26/02/2021 12:15	71.2	83.9	75.0	58.5
26/02/2021 12:30	71.7	88.4	75.4	58.2
26/02/2021 12:45	74.3	97.1	76.2	58.1
26/02/2021 13:00	71.4	86.3	75.4	56.8
26/02/2021 13:15	71.0	85.3	75.0	55.0
26/02/2021 13:30	73.3	97.1	75.6	56.8

ENVIRONMENTAL NOISE ASSESSMENT

Table 17. Results of environmental noise measurements at Position 2.

Date & time	L _{AF,max} [dB]	L _{Aeq} [dB]	L _{A10} [dB]	L _{A90} [dB]
25/02/2021 13:15	65.7	90.7	67.8	54.3
25/02/2021 13:30	64.5	79.4	68.2	54.1
25/02/2021 13:45	64.5	81.6	67.8	53.7
25/02/2021 14:00	64.8	80.1	68.8	54.3
25/02/2021 14:15	64.2	82.7	68.0	53.1
25/02/2021 14:30	64.9	79.7	68.9	54.0
25/02/2021 14:45	64.7	83.5	68.1	53.9
25/02/2021 15:00	64.1	81.2	67.1	53.3
25/02/2021 15:15	64.9	84.5	68.1	54.5
25/02/2021 15:30	64.1	80.8	67.4	53.7
25/02/2021 15:45	65.5	86.6	68.7	54.2
25/02/2021 16:00	65.3	84.4	68.9	54.3
25/02/2021 16:15	65.3	80.9	69.2	54.0
25/02/2021 16:30	64.9	82.7	68.6	53.5
25/02/2021 16:45	65.1	83.3	68.9	54.5
25/02/2021 17:00	64.8	85.5	67.5	54.2
25/02/2021 17:15	64.6	89.0	68.0	53.6
25/02/2021 17:30	65.0	81.8	68.6	53.5
25/02/2021 17:45	63.8	78.7	67.7	53.0
25/02/2021 18:00	64.6	81.3	68.3	52.9
25/02/2021 18:15	63.9	79.5	67.5	52.5
25/02/2021 18:30	63.8	82.1	67.2	52.8
25/02/2021 18:45	62.6	81.4	65.4	52.7
25/02/2021 19:00	63.8	86.4	67.8	52.8
25/02/2021 19:15	63.3	80.4	66.6	51.2
25/02/2021 19:30	63.3	78.0	66.9	51.5
25/02/2021 19:45	62.8	80.0	65.9	52.4
25/02/2021 20:00	62.9	79.3	65.6	52.5
25/02/2021 20:15	63.1	85.5	64.9	52.2
25/02/2021 20:30	62.9	81.0	66.1	51.3
25/02/2021 20:45	63.0	81.8	66.2	51.0
25/02/2021 21:00	62.9	82.3	65.6	51.6
25/02/2021 21:15	63.8	82.0	65.9	49.7
25/02/2021 21:30	61.3	83.2	62.1	49.2
25/02/2021 21:45	61.1	77.2	64.3	48.7

ENVIRONMENTAL NOISE ASSESSMENT

Date & time	L _{AF,max} [dB]	L _{Aeq} [dB]	L _{A10} [dB]	L _{A90} [dB]
25/02/2021 22:00	61.1	81.5	62.7	48.7
25/02/2021 22:15	61.1	84.7	60.5	46.9
25/02/2021 22:30	59.9	81.3	61.1	46.2
25/02/2021 22:45	58.6	79.5	59.1	45.3
25/02/2021 23:00	58.4	80.9	58.6	43.8
25/02/2021 23:15	58.2	82.5	57.6	43.0
25/02/2021 23:30	55.0	75.4	56.6	42.3
25/02/2021 23:45	55.1	81.6	56.0	42.3
26/02/2021 00:00	57.5	76.0	57.6	43.0
26/02/2021 00:15	55.4	78.7	53.7	40.2
26/02/2021 00:30	55.9	79.3	54.3	39.6
26/02/2021 00:45	54.1	75.2	54.5	41.1
26/02/2021 01:00	54.5	79.3	52.3	38.1
26/02/2021 01:15	55.0	81.6	51.5	37.5
26/02/2021 01:30	51.1	74.4	48.6	36.4
26/02/2021 01:45	55.9	79.2	57.8	38.0
26/02/2021 02:00	55.9	77.8	51.9	37.5
26/02/2021 02:15	51.3	75.4	49.9	37.4
26/02/2021 02:30	55.8	80.4	52.7	38.3
26/02/2021 02:45	47.1	64.4	49.1	38.7
26/02/2021 03:00	53.1	77.1	50.7	38.2
26/02/2021 03:15	52.3	74.6	54.8	40.2
26/02/2021 03:30	55.1	80.9	54.0	38.4
26/02/2021 03:45	54.9	76.2	52.4	40.0
26/02/2021 04:00	53.1	75.7	51.7	39.1
26/02/2021 04:15	56.8	75.4	56.2	42.0
26/02/2021 04:30	50.0	67.2	52.5	41.0
26/02/2021 04:45	53.8	78.9	54.8	42.5
26/02/2021 05:00	56.7	77.7	57.1	43.3
26/02/2021 05:15	59.6	82.0	58.5	45.0
26/02/2021 05:30	60.5	79.9	61.5	46.4
26/02/2021 05:45	59.8	79.1	60.9	49.1
26/02/2021 06:00	59.9	78.7	61.8	52.5
26/02/2021 06:15	60.2	79.3	61.7	52.6
26/02/2021 06:30	62.5	85.0	64.1	51.5
26/02/2021 06:45	61.7	79.9	63.7	52.4

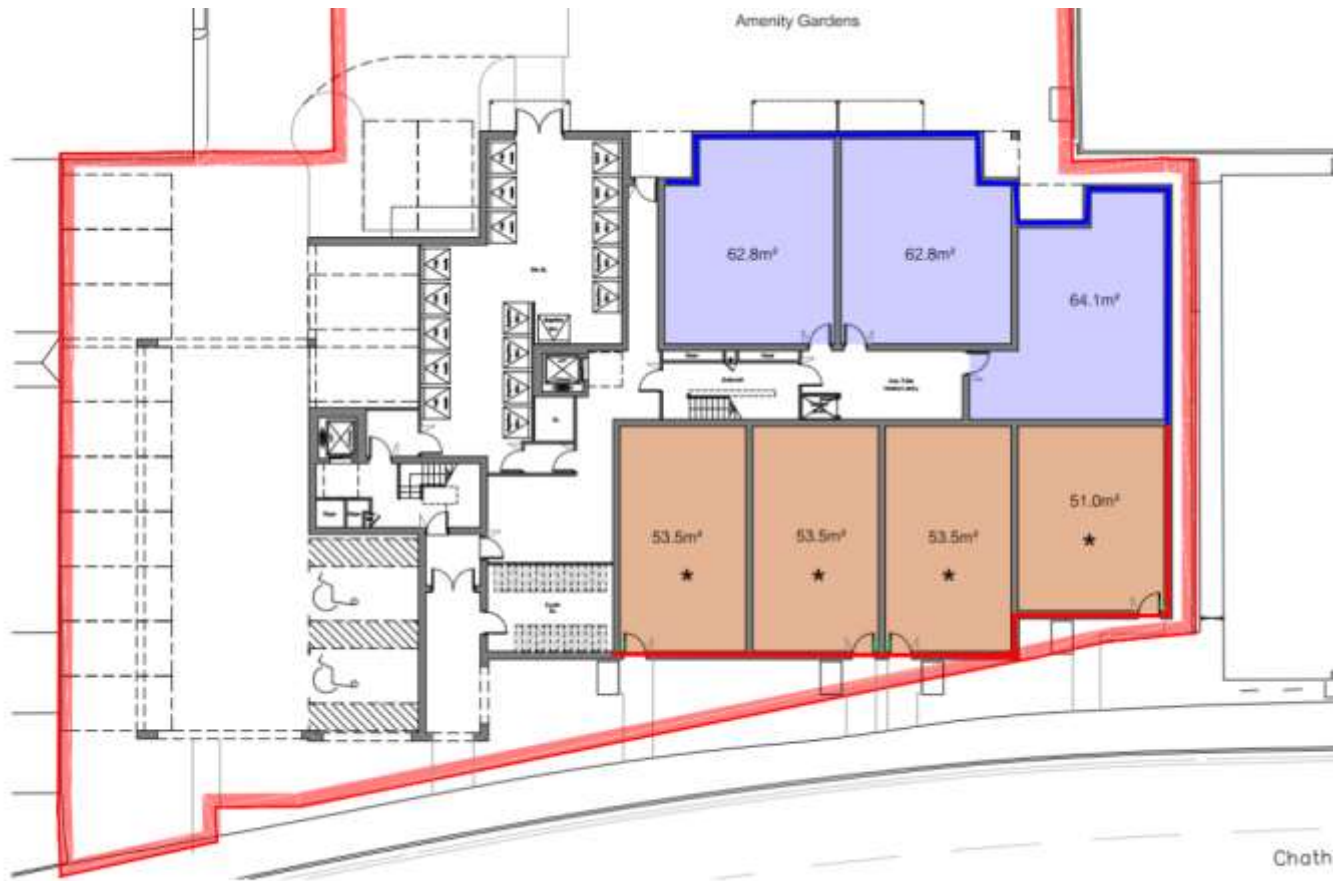
ENVIRONMENTAL NOISE ASSESSMENT

Date & time	L _{AF,max} [dB]	L _{Aeq} [dB]	L _{A10} [dB]	L _{A90} [dB]
26/02/2021 07:00	64.0	82.5	66.4	53.5
26/02/2021 07:15	63.8	81.2	65.7	53.8
26/02/2021 07:30	63.6	81.5	64.9	54.6
26/02/2021 07:45	65.2	83.1	67.9	54.4
26/02/2021 08:00	64.5	81.8	66.9	54.9
26/02/2021 08:15	65.9	83.1	68.9	54.6
26/02/2021 08:30	65.0	80.8	68.1	54.6
26/02/2021 08:45	65.5	82.8	68.4	55.3
26/02/2021 09:00	63.2	79.7	65.1	55.1
26/02/2021 09:15	64.1	83.2	66.5	52.7
26/02/2021 09:30	64.0	82.5	67.0	52.3
26/02/2021 09:45	68.2	88.2	66.9	53.0
26/02/2021 10:00	62.9	79.5	64.9	52.0
26/02/2021 10:15	64.4	87.3	66.6	53.0
26/02/2021 10:30	62.5	79.0	65.1	52.5
26/02/2021 10:45	63.7	77.5	67.4	51.7
26/02/2021 11:00	63.5	86.3	66.3	52.4
26/02/2021 11:15	64.6	92.7	67.5	52.8
26/02/2021 11:30	62.9	78.7	66.3	52.2
26/02/2021 11:45	66.1	84.5	69.0	53.4
26/02/2021 12:00	66.0	87.4	70.0	52.6
26/02/2021 12:15	65.7	92.1	67.9	53.2
26/02/2021 12:30	63.9	79.2	67.6	54.1
26/02/2021 12:45	65.7	83.3	69.2	53.4
26/02/2021 13:00	64.5	79.5	68.4	54.1
26/02/2021 13:15	65.3	80.9	69.1	53.8
26/02/2021 13:30	65.1	80.1	69.3	52.5

APPENDIX C

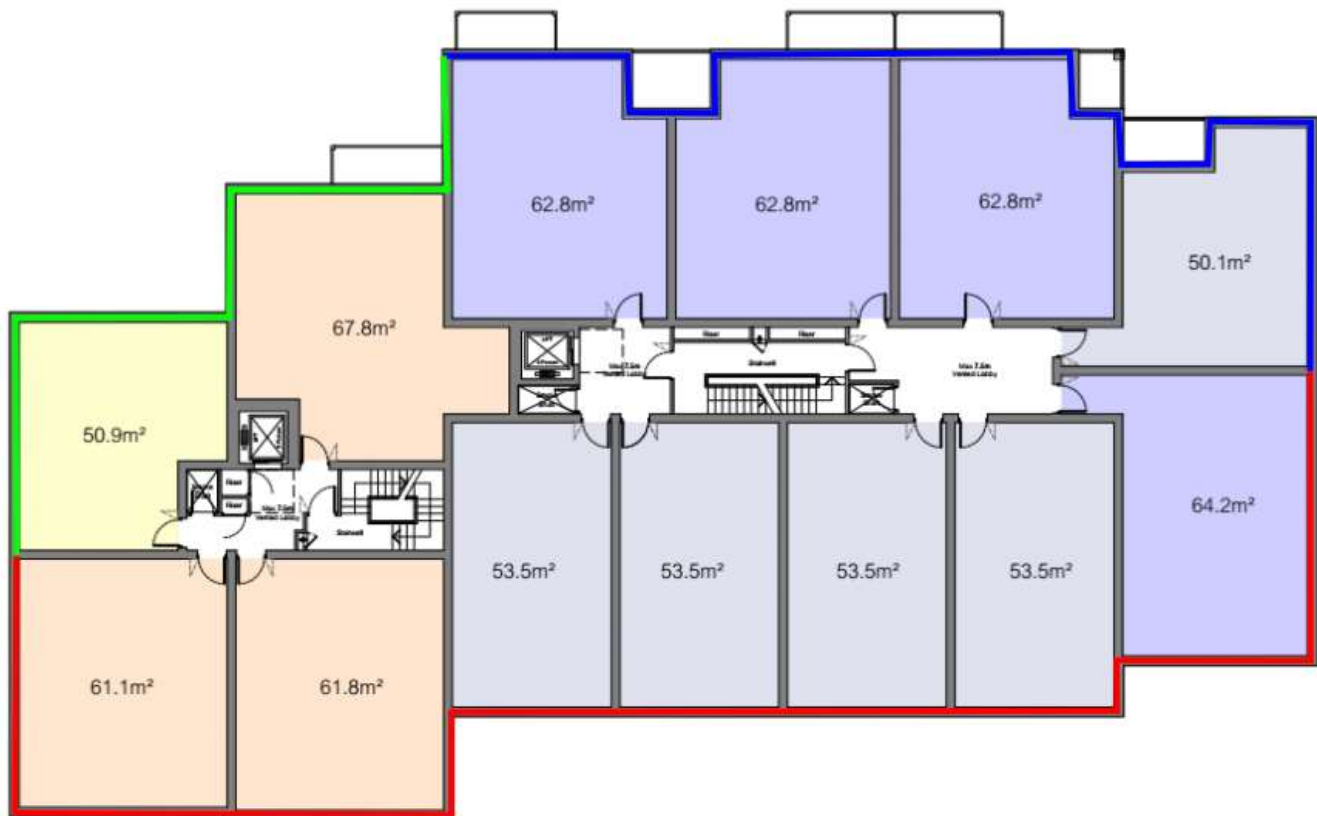
Building envelope acoustic specification identification mark-ups.

Ground Floor:



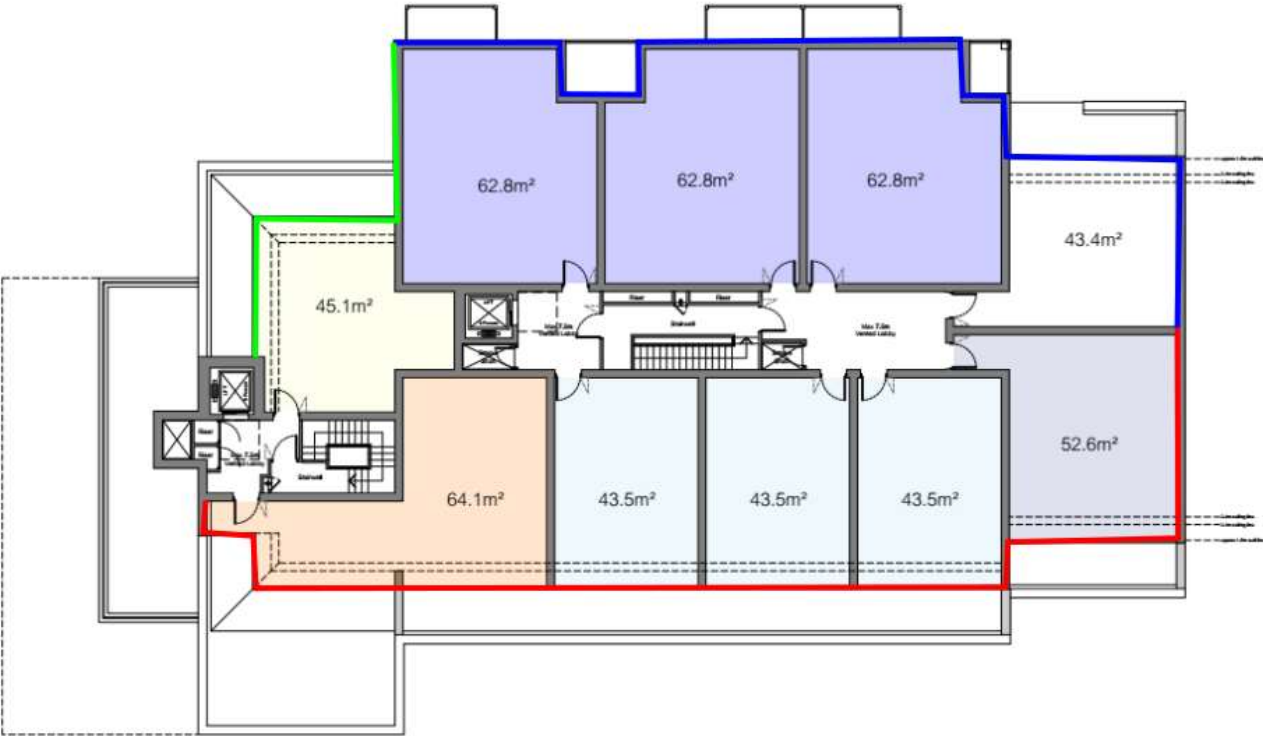
ENVIRONMENTAL NOISE ASSESSMENT

1st-3rd floors (1st floor shown – principles apply to other floors):



ENVIRONMENTAL NOISE ASSESSMENT

4th Floor:



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