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ENVIRONMENTAL CONSULTANTS

Report for:

Parkgrove Development Ltd

1015 Oxford Road, Reading

Noise Assessment

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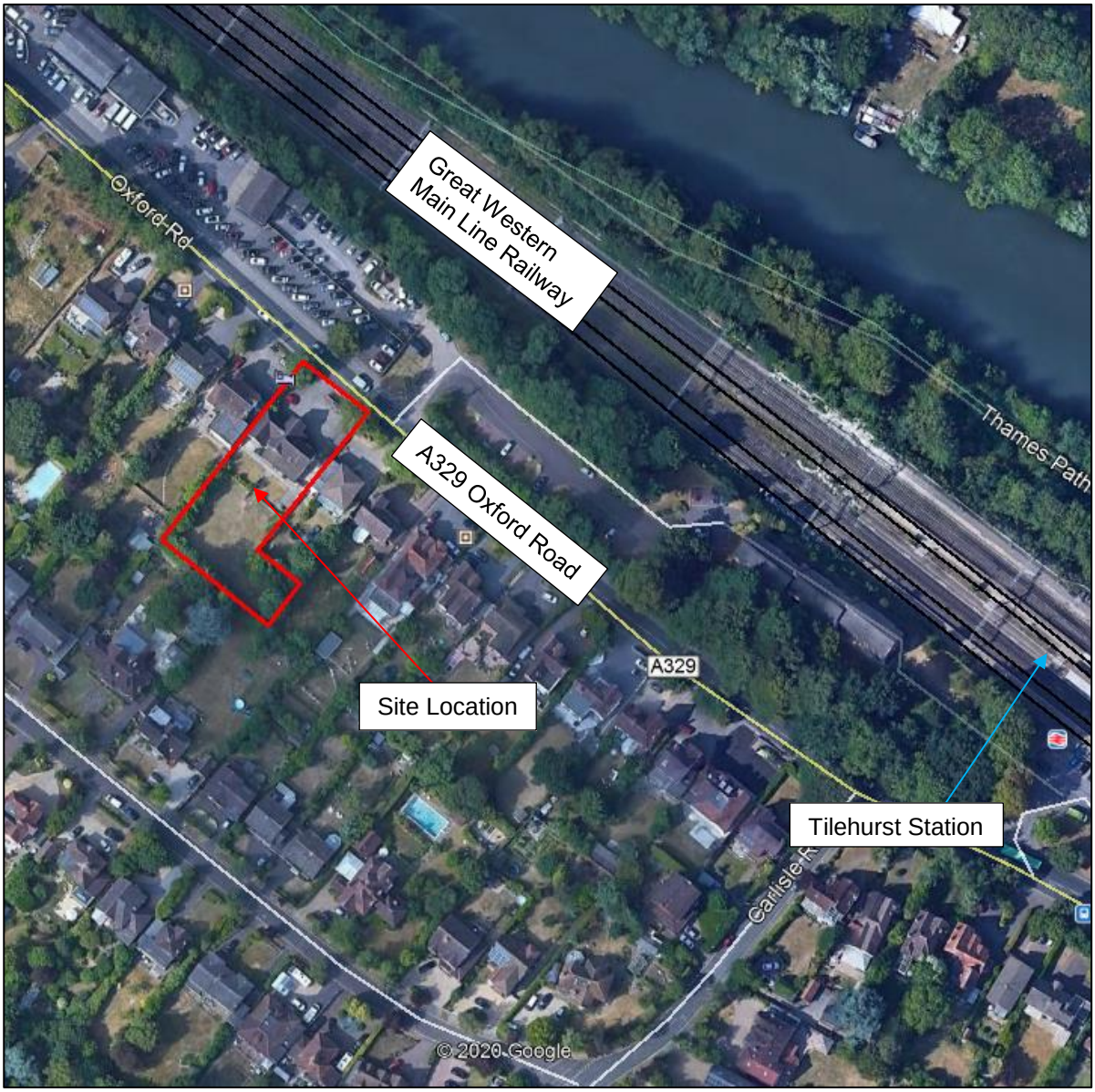
1. INTRODUCTION

1.1. Introduction

ACCON UK Limited (ACCON) has been commissioned by Parkgrove Development Ltd to carry out a noise assessment for the proposed development at 1015 Oxford Road, Reading. The proposed development will comprise the demolition of the existing building and the construction of a three-storey block of 12 residential units.

The site is located within the administrative boundary of Reading Borough Council (RBC). **Figure 1.1** presents a site location plan.

Figure 1.1: Site Location Plan



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1.2. Site Description

The site is located approximately 52 m to the southwest of the Great Western Main Line (GWML) railway and over 200 m to the west of Tilehurst train station. The northeast of the site is bounded by the A329 Oxford Road and the remainder of the site is surrounded by existing residential development.

Due to the distance of the site from the railway line, taking into consideration the set back of the existing and proposed dwellings on the site which increases this distance, it is unlikely that vibration mitigation measures will need to be implemented. Therefore a vibration assessment has not been carried out.

On the basis that the site is over 200 m from the Tilehurst train station and the presence of residential dwellings located closer to the station than the site, it is highly unlikely that station announcements will be audible at the site. The intervening dwellings also provide shielding of activities and sources of noise at the station.

1.3. Noise Assessment Limitations

This noise assessment has been prepared during the Covid-19 pandemic. At the time of writing, noise levels due to road, rail and air traffic are not considered to be typical as people have been asked to remain at home unless their trip is essential. This has resulted in fewer vehicles utilising the roads and a reduced number of train services. As a result, ACCON have carried out a desk-based noise assessment utilising a wide selection of data sources including train timetable information, road traffic data and previous noise measurement surveys.

1.3.1. Consultation with Environmental Protection & Nuisance Team

The Environmental Protection & Nuisance Team (EPNT) at RBC were contacted on 23rd April 2020 to establish their agreement with the proposed desk-based study methodology and to identify any further sources of data. ACCON proposed to:

- "*Review the DEFRA END noise mapping for the site to understand the transportation noise constraints;*
- *Review the December 2019 train timetables to establish typical daily train services and train types which travel through Tilehurst station;*
- *Review any available road traffic data for Oxford Road;*
- *Review any other noise assessments carried out by ACCON or submitted to RBC in support of nearby planning applications over the last 3 years to assist in any data gaps;*
- *Use the above information to inform a CadnaA noise model for the site and use any other noise assessment data and the Defra noise maps to assist in its validation. CadnaA uses the prediction methodologies in the Calculation of Railway Noise (CRN) and the Calculation of Road Traffic Noise (CRTN);*
- *ACCON have recently carried out a specific set of noise measurements in line with CRN of the new Class 800 trains on a section of the line between Reading and Didcot.*

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We propose to use this data to inform the assessment of L_{AFmax} noise levels and as a source term for the input into CadnaA;

- *The assessment will be carried out in line with BS 8233/WHO Guidelines and 45 dB L_{AFmax} criterion as per the RBC comments received via our client and ProPG: Planning and Noise.*
- *Our report will detail the source of all input data including locations of the source data and accessed dates.*"

The desk-based study approach has been endorsed by the Institute of Acoustics and Association of Noise Consultants who have issued a statement on the suitability of noise monitoring at the present time highlighting the current Government advice. Where noise measurement surveys are able to proceed in line with the physical distancing and hygiene guidelines set out by the Government then these surveys should continue as planned. In the case of the site at Oxford Road, the road traffic and railway movements are not considered to be typical and therefore a representative baseline noise climate cannot be measured at this time.

Rebecca Moon, Senior Environmental Health Officer, responded on 29th April 2020 stating "*the methodology you set out in your email regarding a noise assessment for the above site sounds reasonable, in the current circumstances*".

1.3.2. Previous Noise Measurement Surveys

The GWML has undergone an extensive programme of electrification in recent years and, as a result, Great Western Railway (GWR) have introduced a fleet of hybrid (electric and diesel) trains to replace old diesel rolling stock. The Class 387 trains were initially introduced in 2016 and the Class 800 and 802 high speed trains were introduced from late 2018. As such there are no source correction terms available in the Department of Transport's Technical Memorandum *Calculation of Railway Noise* (CRN) or the *Additional railway noise source terms for "Calculation of Railway Noise 1995"* published by Defra in 2007.

ACCON carried out a noise measurement survey in March 2019 of the Class 800 and Class 802 trains to inform a paper submitted to the 26th International Congress on Sound and Vibration in July 2019 (Paper no. 1062, *High Speed Railway Noise Uncertainty Prediction for the Pendolino and the Class 800 Trains in the United Kingdom*). The noise measurements were carried out at Westbury Lane, Purley, approximately 2 km to the northwest of the site at Oxford Road. The noise measurements have been reviewed and repurposed in order to include within a CadnaA noise model for the Oxford Road development site. This includes analysis of Class 387 movements which had also been captured in the March 2019 noise measurement survey.

There are no other noise assessments identified on the RBC or West Berkshire Council websites along this section of the railway line within the last 2 years (i.e. since the introduction of the new Class 800 and Class 802 trains). However, ACCON have also reviewed noise measurements (carried out by ACCON) in March 2020 in Maidenhead and January 2016 in Goring in respect of maximum noise levels (L_{AFmax}).

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2. THE NATURE, MEASUREMENT AND EFFECT OF NOISE

Noise is often defined as sound that is undesired by the recipient. Whilst it is impossible to measure nuisance caused by noise directly, it is possible to characterise the loudness of that noise. 'Loudness' is related to both sound pressure and frequency, both of which can be measured. The human ear is sensitive to a wide range of sound levels. The sound pressure level of the threshold of pain is over a million times that of the quietest audible sound. In order to reduce the relative magnitudes of the numbers involved, a logarithmic scale of decibels (dB) is normally used, based on a reference level of the lowest audible sound.

The response of the human ear is not constant over all frequencies. It is therefore usual to weight the measured frequencies to approximate the human response. The resulting 'A' weighted decibel, dB (A), has been shown to correlate closely to the subjective human response.

When related to changes in noise, a change of ten decibels, for example, from 60 dB(A) to 70 dB(A), would represent a doubling in 'loudness'. Similarly, a decrease in noise, for example, from 70 dB(A) to 60 dB(A), would represent a halving in 'loudness'. A change of 3 dB(A) is generally considered to be just perceptible[1]. **Table 2.1** details typical noise levels.

Table 2.1: Typical Noise Levels

Approximate Noise Level (dB(A))	Example
0	Limit of hearing
30	Rural area at night
40	Library
50	Quiet office
60	Normal conversation at 1 m
70	In car noise without radio
80	Household vacuum cleaner at 1 m
100	Pneumatic drill at 1 m
120	Threshold of pain

A glossary of acoustic terminology is provided in **Appendix 1**.

[1] Institute of Environmental Management and Assessment (2014). Guidelines for environmental noise impact assessment.

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3. NOISE ASSESSMENT CRITERIA

3.1. National Planning Policy Framework

The revised National Planning Policy Framework (NPPF, February 2019 as amended in June 2019) supersedes the 2012 and 2018 versions of the NPPF. The purpose of the planning system is to contribute to the achievement of sustainable development. There are three dimensions to sustainable development: economic, social and environmental. The environmental role is to contribute to protecting and enhancing our natural, built and historic environment; and as part of this, make effective use of land, help to improve biodiversity, use natural resources prudently, minimise waste and pollution, and mitigate to adapt to climate change including moving to a low carbon economy.

One of the core planning principles is to contribute to conserving and enhancing the natural environment and reducing pollution. Allocations of land for development should prefer land of lesser value, where consistent with other policies in the Framework. The planning system should contribute to and enhance the natural and local environment by 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, air, water or noise pollution or land instability.

Paragraph 180 of the NPPF states:

"*Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*

a) Mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life (see Explanatory Note to the Noise Policy Statement for England (Department for Environment, Food and Rural Affairs, 2010));

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."

Additionally, Paragraph 182 states:

"*Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.*"

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3.2. Noise Policy Statement for England

The Noise Policy Statement for England (NPSE) aims to "*through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*

- *Avoid significant adverse impacts on health and quality of life;*
- *Mitigate and minimise adverse impacts on health and quality of life; and*
- *Where possible, contribute to the improvement of health and quality of life*".

Based on concepts from toxicology, it introduces three 'Effect Levels' relevant to the assessment of noise. These 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; and
- SOAEL: Significant Observed Adverse Effect Level: This is the level above which significant adverse effects on health and quality of life occur.

3.3. Planning Practice Guidance

The Planning Practice Guidance for Noise (PPG-N) was published in March 2014 and most recently updated in July 2019. The PPG-N suggests that the most appropriate and cost-effective solutions to potential noise issues are best identified when good acoustic design needs to be considered early in the planning process.

The PPG-N provides the following advice on how to determine the noise impact on development:

"*Plan-making and decision making need to take account of the acoustic environment and in doing so consider:*

- *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.*

In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure (including the impact during the construction phase wherever applicable) is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation. As noise is a complex technical issue, it may be appropriate to seek experienced specialist assistance when applying this policy." (Paragraph 003 Reference ID 30-003-20190722)

The document goes on to acknowledge the levels of noise exposure at which an effect may occur as provided in the NPSE and introduces a fourth effect level:

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- UAE: Unacceptable Adverse Effect: Extensive and regular changes in behaviour and/or an inability to mitigate the effect of noise lead to psychological stress or physical effects.

It is important to understand that as the PPG-N does not specifically provide any advice with respect to noise levels/limits for different sources of noise, it is appropriate to consider other sources of advice and guidance documents when considering whether new developments would be sensitive to the prevailing acoustic environment and the PPG-N signposts a number of appropriate guidance documents.

3.4. Reading Borough Council

ACCON have been furnished with the following information provided by RBC to Parkgrove Development Ltd:

"***Noise impact on development***

The front façade of the development could be affected by road noise and train noise. A noise assessment should be submitted in support of application for new residential proposed in noisy areas.

The noise assessment will be assessed against the recommendations for internal noise levels within dwellings and external noise levels within gardens/balconies in accordance with BS 8233:2014 and WHO Guidelines for Community Noise. The report should identify any mitigation measures that are necessary to ensure that the recommended standard is met.

Where appropriate, the noise assessment data should also include noise events (L_{Amax}) and the design should aim to prevent noise levels from noise events exceeding 45 dB within bedrooms at night. Noise levels above 45 dB are linked with sleep disturbance.

It may be possible through clever design to reduce the need for additional noise mitigation measures, for example, ensuring that noise sensitive rooms are located on the quieter façades and bathrooms, kitchens, hallways and cupboards etc on the noisiest façades.

Noise mitigation is likely to focus on the weak point in the structure, glazing. Given that the acoustic integrity would be compromised should the windows be opened, ventilation details must also be provided, where mitigation relies on closed windows. Ventilation measures should be selected which do not allow unacceptable noise ingress and should provide sufficient ventilation to avoid the need to open windows in hot weather, however non-openable windows are not considered an acceptable solution due to the impact on living standards."

Additional information was provided regarding noise generating development:

"*Applications which include noise generating plant when there are nearby noise sensitive receptors should be accompanied by an acoustic assessment carried out in accordance with BS 4142:2014 methodology. It is likely that this development will include noisy mechanical plant such as air conditioning, kitchen extraction, generator, externally ventilated plant room.*

The noise assessment needs to establish the predicted noise rating level taking account of any characteristic factors like tonality or impulsiveness of the noise. The rating level should be compared with the background noise level.

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Our noise policy states for proposed new plant:

The noise source specific noise level (plant noise level) should be at least 10 dB(A) below the existing background level as measured at the nearest noise sensitive receptor and the rating level should not exceed the background level (as measured in accordance with BS 4142:2014)."

3.5. Noise Guidance

3.5.1. Professional Practice Guidance on Planning and Noise: New Residential Development

The Professional Practice Guidance (ProPG) on Planning and Noise for New Residential Development was published in May 2017 and was produced to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England.

The recommended approach detailed in the ProPG includes a framework to enable situations where noise is not an issue to be clearly determined, and to help identify the extent of risk at noisier sites. The recommended approach provides opportunities to incorporate effective design interventions that will enable residential development to proceed in areas that might otherwise have been considered unsuitable.

The ProPG provides advice for Local Planning Authorities and developers, and their respective professional advisers. It aims to complement Government planning and noise policy and guidance. In particular, it strives to:

- Advocate full consideration of the acoustic environment from the earliest possible stage of the development control process;
- Encourage the process of good acoustic design in and around new residential developments;
- Outline what should be taken into account in deciding planning applications for new noise-sensitive developments;
- Improve understanding of how to determine the extent of potential noise impact and effect; and
- Assist the delivery of sustainable development.

The two sequential stages of the recommended approach are:

- Stage 1: an initial noise risk assessment of the proposed development site; and
- Stage 2: a systematic consideration of four key elements.

The four key elements to be undertaken in parallel during Stage 2 of the recommended approach are:

- Element 1: demonstrating a “Good Acoustic Design Process”;
- Element 2: observing internal “Noise Level Guidelines”;
- Element 3: undertaking an “External Amenity Noise Assessment”; and

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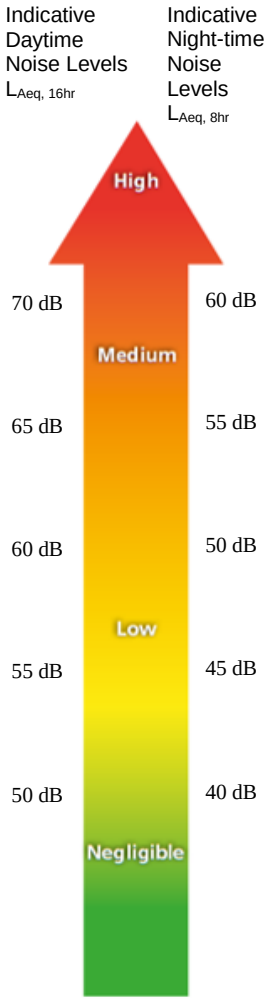
- Element 4: consideration of “Other Relevant Issues”.

Figure 3.1 below identifies the guidance given in the ProPG when undertaking the risk assessment stage for a site.

Figure 3.1: Phase 1 – Noise Risk Assessment

Noise Risk Assessment	Potential Effect Without Noise Mitigation	Pre-Planning Application Advice
	Increasing risk of adverse effect	High noise levels indicate that there is an increased risk that development may be refused on noise grounds. This risk may be reduced by following a good acoustic design process that is demonstrated in a detailed ADS. Applicants are strongly advised to seek expert advice. As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised, and which clearly demonstrates that a significant adverse noise impact will be avoided in the finished development. At low noise levels, the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development.
	No adverse effect	These noise levels indicate that the development site is likely to be acceptable from a noise perspective, and the application need not normally be delayed on noise grounds.

Notes:

1. Indicative noise levels should be assessed without inclusion of the acoustic effect of any scheme specific noise mitigation measures.
2. Indicative noise levels are the combined free-field noise levels from all sources of transport noise and may also include industrial/commercial noise where this is present but is “not dominant”.
3. $L_{Aeq, 16hr}$ is for daytime 0700 - 2300, $L_{Aeq, 8hr}$ is for night-time 2300 - 0700.
4. An indication that there may be more than 10 noise events at night (2300 - 0700) with L_{AFmax} > 60 dB means the site should not be regarded as negligible risk.

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Table 3.1 below identifies the internal noise level criteria provided in the ProPG.

Table 3.1: ProPG Noise Levels

Activity	Location	0700-2300 Hours	2300-0700 Hours
Resting	Living room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$ 45 dB L_{AFmax} Note 4

Notes:

1. The Table provides recommended internal L_{Aeq} target levels for overall noise in the design of a building. These are the sum total of structure-borne and airborne noise sources. Ground-borne noise is assessed separately and is not included as part of these targets, as human response to ground-borne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity.
2. The internal L_{Aeq} target levels shown in the Table are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g. 1 hour, may be used, but the level should be selected to ensure consistency with the internal L_{Aeq} target levels recommended in the Table.
3. These internal L_{Aeq} target levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year's Eve.
4. 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_{AFmax}, depending on the character and number of events per night. Sporadic noise events could require separate values. In most circumstances in noise sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB L_{AFmax} more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events (see Appendix A).
5. Designing the site layout and the dwellings so that the internal target levels can be achieved with open windows in as many properties as possible demonstrates good acoustic design. Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the "open" position and, in this scenario, the internal L_{Aeq} target levels should not normally be exceeded, subject to the further advice in Note 7.
6. Attention is drawn to the requirements of the Building Regulations.
7. Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal L_{Aeq} target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved. The more often internal L_{Aeq} levels start to exceed the internal L_{Aeq} target levels by more than 5 dB, the more that most people are likely to regard them as "unreasonable". Where such exceedances are predicted, applicants should be required to show how the relevant number of rooms affected has been kept to a minimum. Once internal L_{Aeq} levels exceed the target levels by more than 10 dB, they are highly likely to be regarded as "unacceptable" by most people, particularly if such levels occur more than occasionally. Every effort should be made to avoid relevant rooms experiencing "unacceptable" noise levels at all and where such levels are likely to occur frequently, the development should be prevented in its proposed form (**see Section 3.D**).

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3.5.2. British Standard BS 8233:2014

BS 8233 *Guidance on sound insulation and noise reduction for buildings* has a number of design criteria for intrusive external noise without a specific character. The guidelines are designed to achieve reasonable resting/sleeping conditions in bedrooms and good listening conditions in other rooms. The most appropriate noise levels (Table 4 of the BS) for the residential environment are reproduced in **Table 3.2**.

Table 3.2: Indoor Ambient Noise Levels for Dwellings

Activity	Location	Daytime 0700 hrs to 2300 hrs	Night-time 2300 hrs to 0700 hrs
Resting	Living room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$

Although there are no limits set for external noise levels in BS 8233 the following guidance is provided at paragraph 7.7.3.2:

"*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.*"

3.5.3. Acoustics Ventilation and Overheating Guide

The Acoustics Ventilation and Overheating Guide (AVO Guide) was published in January 2020. It is intended to be used by acoustics practitioners as well as all those involved in the planning, development, and design and commissioning of new dwellings. It aims to assist designers to adopt an integrated approach to the acoustic design within the context of the ventilation and thermal comfort requirements. The AVO Guide is intended to demonstrate good acoustic design as described in the ProPG when considering internal noise level guidelines.

For the purpose of the document, overheating is taken to mean:

"*the phenomenon of excessive or prolonged high temperatures in homes, resulting from internal or external heat gains, which may have adverse effects on the comfort, health or productivity of occupants.*"

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The AVO Guide is intended for new residential development predominantly exposed to transportation noise sources. The approach can also be considered for other types of residential development such as residential institutions, care homes, etc. although it needs to be remembered that some of the occupants of these types of premises can be more sensitive to indoor environmental conditions.

The AVO Guide includes:

- An explanation of the ventilation requirements under The Building Regulations as described in *Approved Document F – Means of Ventilation 2010 Edition* (ADF) along with typical ventilation strategies and associated noise considerations;
- An explanation of the overheating assessment methodology described in CIBSE *Design methodology for the assessment of overheating risk in homes* (TM59);
- A potential acoustic scale and guidance relating to different ventilation and overheating conditions, for both environmental noise ingress and building services noise; and
- A worked example of the application of the AVO Guide including indicative design constraints for different ventilation and overheating mitigation strategies.

The AVO Guide provides a two-level assessment procedure for the overheating condition. The first level assessment is a site risk assessment based on external noise levels and the assumption that the opening of windows is the primary means of mitigating overheating. A scale is provided which is related to the ProPG initial site noise risk assessment. **Figure 3.2** presents a copy of the AVO Guide Level 1 risk assessment scale.

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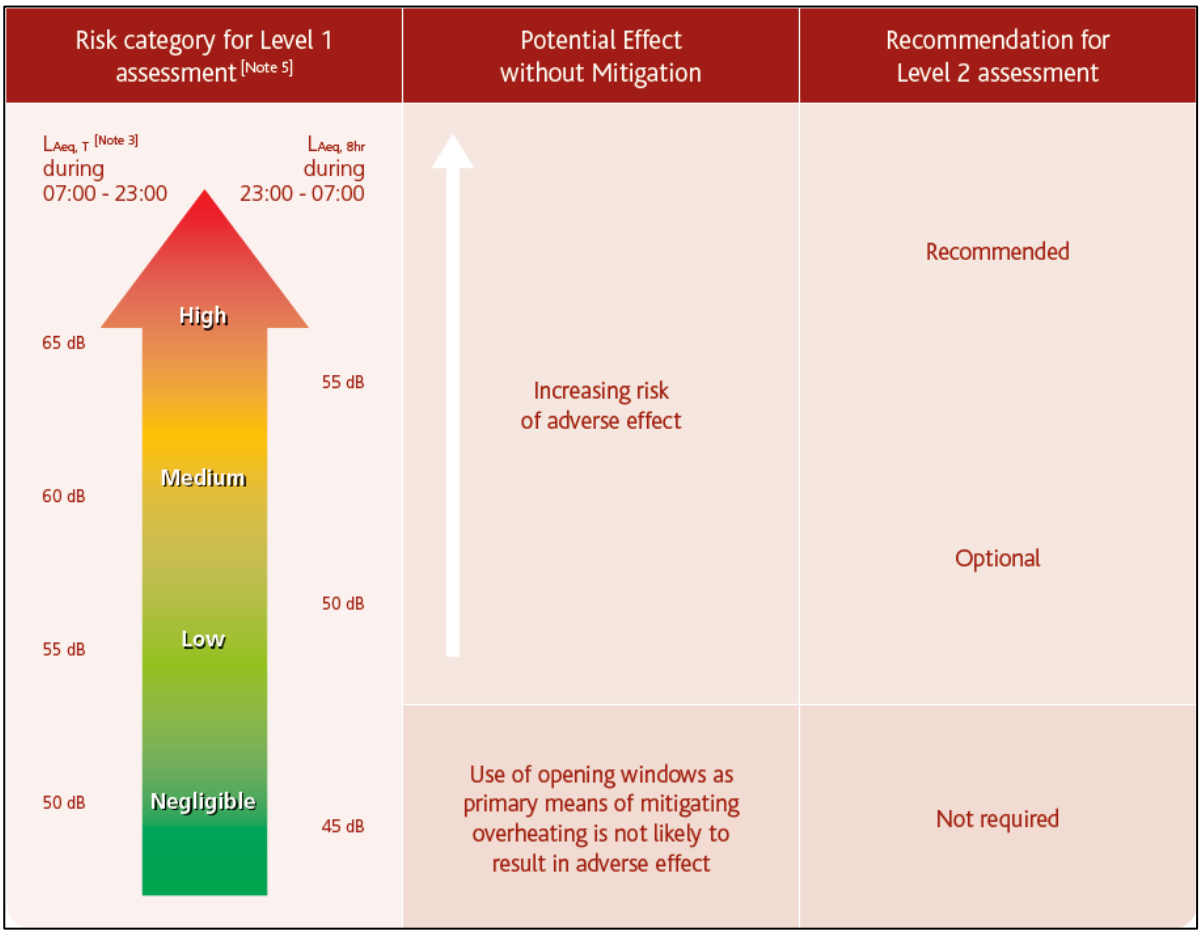
Figure 3.2: AVO Guide Level 1 Risk Assessment Guidance



Note 1: The noise levels suggested assume a steady road traffic noise source but may be adapted for other types of transport. All levels are external free-field noise levels.
Note 2: The values presented in this table should not be regarded as fixed thresholds and reference can also be made to relevant dose-response relationships.
Note 3: A decision must be made regarding the appropriate averaging period to use. The averaging period should reflect the nature of the noise sources, the occupancy profile and times at which overheating might be likely to occur. Further guidance can be found within the 2014 IEMA Guidelines.
Note 4: Where 78 dB LAFmax is normally exceeded during the night-time period (2300 hrs to 0700 hrs), a level 2 assessment is recommended.
Note 5: The risk of an adverse effect occurring will also depend on how frequently and for what duration the overheating condition occurs.
Note 6: To evaluate the risk category for a dwelling, all three aspects of external noise exposure (i.e. daytime, night-time and individual noise events) should be evaluated. The highest risk category for any of these aspects applies.

The second level assessment considers the potential for adverse effect on occupants based on the internal ambient noise levels. LOAELs are identified as the typical target internal noise levels as outlined in ProPG, BS 8233 and the WHO Guidelines. SOAELs can be derived from a variety of sources including published research, guidance and dose-response relationships. In general, the SOAEL will depend on the duration of the overheating event. A lower SOAEL will be more applicable where the overheating condition will occur for a longer duration and as a result, adverse noise impacts could cause greater behavioural changes. Higher SOAEL levels are more applicable where the overheating condition will rarely occur

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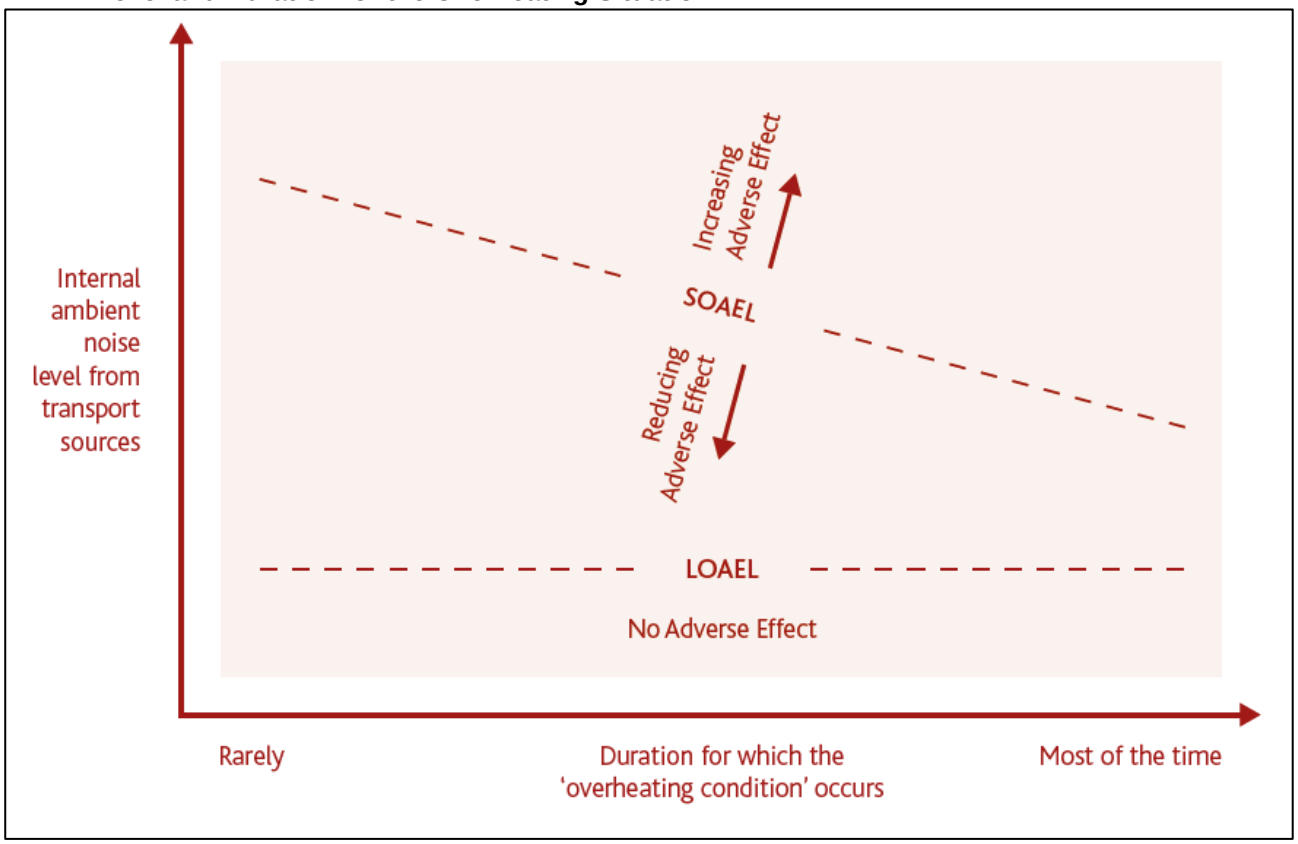
as the likelihood of experiencing such high noise levels will be for a much more limited amount of time thus resulting in reduced adverse effects such as changes in behaviour.

The AVO Guide provides qualitative guidance on the combined effect of internal ambient noise level and duration for the overheating situation. **Figure 3.3** presents the example identified in Figure 3-2 of the guide. The relevant LOAEL and SOAEL noise levels can be ascribed to the vertical axis. A point can be located where the associated internal noise level and overheating condition meet. If the point is located above the SOAEL line, a combination of noise mitigation and overheating mitigation can be considered to bring the point within the LOAEL-SOAEL range.

Figure 3.3: AVO Guide Qualitative Guidance on Combined Effect of Internal Ambient Noise Level and Duration for the Overheating Situation



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3.6. Target Noise Levels

The following target noise levels have been derived from the above Noise Guidance and the comments from RBC.

3.6.1. External Noise Levels

Noise levels within private amenity areas should achieve a noise level within or below the range 50 dB to 55 dB $L_{Aeq,\ 16hr}$ during the daytime period.

3.6.2. Internal Noise Levels

Noise levels within habitable rooms (i.e. living rooms and bedrooms) should normally achieve a daytime noise level not exceeding 35 dB $L_{Aeq,16hr}$ and a night-time noise level not exceeding 30 dB $L_{Aeq,8hr}$. Maximum noise levels (L_{AFmax}) should not normally exceed 45 dB internally more than ten times during the night-time.

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4. NOISE MODELLING AND ASSESSMENT INPUT DATA

4.1. Defra Environmental Noise Directive (END) Strategic Noise Maps

Figure F.1 to **Figure F.4** present extracts from END Round 3 Strategic Noise Maps for the proposed development site. These noise maps are prepared using a 10 m calculation grid at a height of 4 m above ground level.

Figure F.1 presents an extract of the $L_{Aeq,16hr}$ noise contours for railway noise. It identifies that the front of the existing building is partly within the 60.0 dB(A) to 64.9 dB(A) noise contour. However, the rear of the existing building is outside of the noise contours, i.e. noise levels due to the railway line are less than 55.0 dB(A).

Figure F.2 presents the extract of the L_{night} noise contours for railway noise. It identifies that the front of the existing building is within the 55.0 dB(A) to 59.9 dB(A) noise contour. However, the rear of the existing building is outside of the noise contours, i.e. noise levels due to the railway line are less than 50.0 dB(A).

Figure F.3 presents the extract of the $L_{Aeq,16hr}$ noise contours for road traffic noise. It identifies that the front of the existing building is within the 65.0 dB(A) to 69.9 dB(A) noise contour. However, the rear of the existing building is outside of the noise contours, i.e. noise levels due to road traffic are less than 55.0 dB(A).

Figure F.4 presents the extract of the L_{night} noise contour for road traffic noise. It identifies that the front of the existing building is within the 55.0 dB(A) to 59.9 dB(A) noise contour. However, the rear of the existing building is outside of the noise contours, i.e. noise levels due to road traffic are less than 50.0 dB(A).

4.2. Noise Modelling Software

The CadnaA noise modelling software has been utilised to calculate the external noise levels from road traffic and railway movements at the proposed development site. CadnaA is a three-dimensional noise model developed by DataKustik and has been extensively used by ACCON and others to develop noise models for a wide variety of situations and noise sources. CadnaA utilises the methodology in the Department of Transport's Technical Memorandums *Calculation of Road Traffic Noise* (CRTN) and *Calculation of Railway Noise* (CRN) to predict noise from road traffic sources and railway movements respectively.

4.3. Road Traffic Noise

The 24-hour Average Annual Daily Traffic (AADT) flows for the A329 Oxford Road have been obtained from the Department for Transport's (DfT) Road Traffic Statistics website[2]. The most recent data, 2018, has been estimated from a manual count in 2016. The total number of motor vehicles is 18,313 a day of which less than 1% are heavy goods vehicles (HGVs).

CRTN typically utilises the 18-hour (between 0600 hrs and 0000 hrs) Average Annual Weekday Traffic (AAWT). The difference in predicted noise levels between the use of 24 -

[2] Retrieved from https://roadtraffic.dft.gov.uk/manualcountpoints/73898 24th April 2020

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hour AADT and the use of 18-hr AAWT traffic data is ordinarily negligible (less than ±0.5 dB) therefore a correction has not been applied to obtain 18-hr AAWT traffic levels.

An average growth factor of 1.01 has been determined by comparing the 24-hour AADT flows for the years 2007 to 2018. This factor has been utilised to increase the 2018 traffic flows to 2022 which provides a reasonable estimate of the opening year of the proposed development. The calculated 2022 24-hour AADT is 19057 vehicles. It is assumed, based on the 2018 data, that approximately 1% of vehicles would be HGVs.

4.4. Railway Data

The working train timetables for December 2019 to May 2020 published on the Network Rail website[3] have been reviewed to establish the number of passenger and freight train services passing through Tilehurst station on a typical weekday.

Table 4.1 provides a summary of the data input into the CadnaA noise model.

Table 4.1: Railway Noise Input Data

Train Class	Direction of Travel and Track(1)	Number of Movements		Source of Data or Correction Term(3)	Predicted Noise Level $L_{Aeq,T}$ (dB) at 25 m	
		Daytime (2)	Night-time(2)		Daytime	Night-time
Class 800/802 (GWR)	Didcot 1	133	12	Noise measurements	59.6	47.2
	Reading 2	136	10		59.7	46.4
Class 221 (Cross Country)	Didcot 1	30	2	CRN/Defra	49.5	40.7
	Reading 2	31	3		49.6	42.5
Class 387	Didcot 3	34	7	Noise measurements	38.7	27.9
	Reading 4	36	8		39.0	28.4
Class165	Didcot 3	10	4	CRN	36.7	35.8
	Reading 4	10	4		36.7	35.8
Night Riviera Sleeper Service(4)	Didcot 3	0	1	CRN	-	41.4
	Reading 4	0	1		-	41.4

[3] Retrieved from https://www.networkrail.co.uk/running-the-railway/the-timetable/working-timetable 24th April 2020

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Train Class	Direction of Travel and Track(1)	Number of Movements		Source of Data or Correction Term(3)	Predicted Noise Level $L_{Aeq,T}$ (dB) at 25 m	
		Daytime (2)	Night-time(2)		Daytime	Night-time
Freight Class 66 & Wagons(5)	Didcot 3	50(6)	28(6)	Defra	68.3	68.5
	Reading 4	35(6)	41(6)		67.3	70.6

Notes:

(1) Track 1 is closest to the proposed development site and typically carries fast/semi-fast train services towards Didcot. Track 2 typically carries fast/semi-fast train services towards Reading. Track 3 typically carries stopping and slower services towards Didcot. Track 4, the furthest from the proposed development site, typically carries stopping and slower services towards Reading. Train classes have been modelled on the track which they most frequently are expected to travel.

(2) Daytime: 0700 hrs to 2300 hrs; Night-time: 2300 hrs to 0700 hrs.

(3) Source term correction factors have been obtained from CRN (through CadnaA) or the *Additional railway noise sources terms for "Calculation of Railway Noise 1995*" document published in 2007 by Defra.

(4) The Night Riviera Service is hauled by a Class 57 locomotive (a correction term is not available therefore this has been modelled as a Class 59 locomotive) and includes seven Mark 3 carriages.

(5) The majority of freight services are hauled by Class 66 locomotives (95%). The number of wagons each locomotive hauls ranges from 6 to 48 with a median value of 12. The assumed types of wagon have been based on a mix of HTA, MEA, TDA and KQA pocket wagons for which source correction terms are provided in the 2007 Defra document.

(6) The number of movements identified in **Table 4.1** represents a reasonable typical weekday by considering those freight services timetabled for at least three days of the week. Not all freight services run daily, some services are '*run as required*' by the operator and some can take alternative routes if necessary.

4.5. Maximum Noise Levels

4.5.1. Road Traffic Noise

A maximum noise level of 80 dB L_{AFmax} measured at 4 m from the side of the carriageway of Oxford Road at a height of 1.5 m is assumed as a worst case. This maximum noise level has been measured by ACCON on a number of similar roads.

4.5.2. Railway Noise

Table 4.2 presents a summary of maximum noise levels measured by ACCON on the GWML. All of the measured data have been corrected to 25 m from the railway line for comparison.

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Table 4.2: Measured Maximum Noise Levels

Measurement Date	Notes	Measured Maximum Noise Level L_{AFmax} (dB)	Distance from Railway Line (m)	Corrected Maximum Noise Level to 25 m from Railway Line L_{AFmax} (dB)
March 2019	Class 800 and 802 trains at Purley travelling approximately 180 km/h	81	25	81
	'Slow' moving (approx. 64 km/h) Class 387 train at Purley	64	25	64
March 2020	Maidenhead (1.3 km from station) Tenth highest measured night-time L_{AFmax}	83	19	81
January 2016	Goring (1.4 km from station) Tenth highest measured night-time L_{AFmax}	92	8	82

The noise measurements carried out in March 2019 focused on passenger trains and did not include noise measurements during the night-time. However, it can be identified from **Table 4.2** that noise measurements carried out both before the change in passenger fleet and very recently recorded similar tenth-highest L_{AFmax} noise levels. The night-time noise measurements at both the Goring and Maidenhead sites would have included a mix of freight and passenger trains.

A maximum noise level of 81 dB L_{AFMax} at a distance of 25 m from the railway line has been utilised in the assessment to represent a worst case tenth highest L_{AFmax} noise level.

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5. ACOUSTIC DESIGN STATEMENT

5.1. Stage 1: ProPG Initial site noise risk assessment

For the purpose of the initial site noise risk assessment, it has been assumed that the site topography will not be significantly altered from the current topography. The noise model does not include any other structures or site features that are likely to affect the noise levels (i.e. by shielding) across the site which will be retained or removed as part of the proposed development.

A growth factor has been applied to the available road traffic data to take into account any traffic growth up to the year 2022 as a reasonable estimated occupation year for the proposed development. There is currently a degree of uncertainty in respect of future road traffic noise levels beyond this as a result of potential long-term changes in working patterns. However, it should be noted that a reduction or increase in traffic volumes of 20% or 25%, respectively, in the future would only result in a change in traffic period noise levels of 1 dB(A) and no change in the maximum noise levels.

It is considered unlikely that railway noise will significantly increase over the next 15 years based on the recent significant changes to the GWR fleet and the electrification of the GWML. December 2019 brought a significant change in timetabling as a result of these changes which had not been seen in previous years and it is this timetable which has been reviewed for this assessment. It is unlikely that the number of trains will be increased significantly and any increases to the lengths of shorter trains is unlikely to have a noticeable effect on the noise levels at the proposed development site.

Figure F.5 presents the daytime and night-time initial site noise risk assessment noise contours for the proposed development site at a height of 1.5 m above ground level. This is representative of ground floor level receptors. **Figure F.6** presents the daytime and night-time initial site noise risk assessment noise contours for the proposed development site at a height of 4 m above ground level. This is representative of first floor level receptors.

Figure F.5 and **Figure F.6** identify that the site is generally of low noise risk during the daytime, however, this increases towards medium within approximately 23 m of Oxford Road at ground floor and 28 m of Oxford Road at first floor.

During the night-time, the site is generally of medium noise risk. At first floor level, the risk increases to high within approximately 25 m of Oxford Road. Night-time maximum noise levels due to train movements are also likely to place the site at medium to high risk during the night-time.

Figure F.5 and **Figure F.6** demonstrate the noise shielding effects of the adjacent buildings to the external garden areas to the southwest of the buildings.

5.2. Stage 2: External Noise Levels

The proposed ground floor plan for the proposed building is presented in **Figure F.7**. There are no balconies proposed as part of the development, however, the site benefits from a large rear garden area. **Figure F.8** presents the predicted external noise contours for the development site. **Figure F.8** identifies that the rear garden amenity space is predicted to

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experience noise levels below 50 dB $L_{Aeq,16hr}$. Therefore, no noise mitigation measures are required for external amenity areas.

5.3. Stage 2: Internal Noise Levels

5.3.1. Predicted Noise Levels

Table 5.1 presents the predicted noise levels external to the habitable rooms of the proposed dwelling. The maximum noise levels identified in **Section 4.5** have been corrected for distance to the nearest windows with line of site to those noise sources with the highest predicted L_{AFmax} (of road traffic and railway noise) external to the habitable rooms presented in **Table 5.1**. The fifth column of **Table 5.1** identifies the minimum sound reduction that the building façade (glazing, ventilation openings and external wall build up) will need to provide in order to ensure that the target internal noise levels (refer to **Section 3.6.2**) are not exceeded.

Table 5.1: Predicted External Noise Levels and Minimum Combined Façade Sound Reduction Requirements

Receptor Location	Predicted Daytime External Noise Level $L_{Aeq,16hr}$ (dB)	Predicted Night-time External Noise Level $L_{Aeq,8hr}$ (dB)	Predicted External Maximum Noise Level L_{AFmax} (dB)	Minimum Combined Façade Sound Reduction Required dB(A)
Northeast Façades				
Ground Floor	62	59	72	29
First Floor	64	62	72	32
Second Floor	66	64	72	34
Southwest Façades				
Ground Floor	45	45	-(1)	15
First Floor	45	45	-(1)	15
Second Floor	46	45	-(1)	15

Note (1): These façades do not have line of site to the road traffic or railway noise sources.

Table 5.1 identifies that the habitable rooms with windows on the northeast façades will require the highest levels of building envelope sound reduction.

Assuming that the external wall construction provides a minimum sound reduction of 50 dB R_w (typically achievable by a standard brick and block cavity wall construction, or similar), the glazing and any ventilation openings will be the weakest elements of the building façade. Therefore, double glazed windows will need to achieve a minimum sound reduction level of 34 dB(A) to ensure that the target internal noise levels are not exceeded in bedrooms and living spaces.

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A typical double glazed window system (i.e. in a 4 mm glass, 6-16 mm air gap, 6 mm glass formation) can provide up to 28 dB(A) sound reduction. This would be suitable for windows on the southwestern façades of the building.

A sound reduction of 34 dB(A) could be achieved by the following, or similar, products:

- Pilkington 6 mm glass, 16 mm argon filled air gap, 6.8 mm Optiphon laminated glass;
- Saint-Gobain 10 mm glass, 16 mm air gap, 8.8 mm laminated glass;
- AGC 10 mm glass, 15 mm air gap, 6 mm Thermobel glass.

5.3.2. Acoustics and Ventilation

Whole dwelling ventilation is defined in the Building Regulations Approved Document F (ADF) as the dilution and removal of pollutants and water vapour not removed by extract ventilation. Extract ventilation is the removal of air directly from a space such as a bathroom or kitchen to the outside. Four systems are described in ADF which will comply with the Building Regulations for whole dwelling and extract ventilation. Open windows are not a valid means of whole dwelling or extract ventilation under the Building Regulations.

Purge ventilation is typically only required for short periods of time to let out smoke or an odour. When purge ventilation is required by opening windows, exposure to noise will only increase for a very short period of time and is not considered to be a material consideration for occupiers of the proposed development.

The ventilation systems identified in ADF are summarised in **Table 5.2** for whole dwelling ventilation, extract ventilation and purge ventilation.

Table 5.2: Approved Document F Ventilation Systems

Ventilation System	Provision with ADF System/Purpose		
	Whole Dwelling Ventilation	Extract Ventilation	Purge Ventilation
System 1: Background ventilators and intermittent extract fans	Background ventilators (trickle vents)	Intermittent extract fans	Typically provided by opening windows
System 2 Passive stack (“natural”)	Background ventilators (trickle vents) and passive stack ventilation	Continuous via passive stack	Typically provided by opening windows
System 3: Continuous mechanical extract (MEV)	Continuous mechanical extract – minimum low rate Trickle vents provide inlet air	Continuous mechanical extract – minimum high rate Trickle vents provide inlet air	Typically provided by opening windows

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Ventilation System	Provision with ADF System/Purpose		
	Whole Dwelling Ventilation	Extract Ventilation	Purge Ventilation
System 4: Continuously mechanical supply and extract with heat recovery (MVHR)	Continuous mechanical supply and extract – minimum low rate	Continuous mechanical supply and extract – minimum high rate	Typically provided by opening windows

For flats to the rear of the proposed building (those not overlooking the road and railway line on the southwest façades), the ADF ventilation requirements should be achievable through the provision of means of ventilation complying with ADF Systems 1, 2, 3 or 4.

For flats to the front of the proposed building (those overlooking the road and railway line on the northeast façades) and considering the advice in **Section 5.3.3** below in respect of overheating, a System 3 or 4 mechanical-based ventilation system should be considered. For all flats, windows should be openable for purge ventilation and overheating mitigation.

5.3.3. Acoustics and Overheating

The requirement to achieve the target internal noise levels with windows closed may result in unintended adverse consequences associated with thermal comfort.

In respect of thermal comfort, noise can be considered an issue as windows may otherwise need to be left open for an extended period of time, for example, on warm summer days and nights. In Britain, the requirement for keeping windows open for thermal comfort is typically limited to a relatively small number of days during May to September.

BS 8233 states that *"if partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB"*. The WHO guidelines also state that *"a slightly open window would result in a [sound] reduction from outside to inside of 15 dB"*.

Utilising the predicted external noise levels identified in **Table 5.1**, the corresponding internal noise levels with open windows for ventilation are presented in **Table 5.3**.

Table 5.3: Predicted External Noise Levels and Minimum Combined Façade Sound Reduction Requirements

Receptor Location	Predicted External Noise Level (dB)			Calculated Internal Noise Level (dB)		
	Daytime $L_{Aeq,16hr}$	Night-time $L_{Aeq,8hr}$	Night-time L_{AFmax}	Daytime $L_{Aeq,16hr}$	Night-time $L_{Aeq,8hr}$	Night-time L_{AFmax}
Northeast Façades						
Ground Floor	62	59	72	47 (X)	44 (X)	57 (X)
First Floor	64	62	72	49 (X)	47 (X)	57 (X)
Second Floor	66	64	72	51 (X)	49 (X)	57 (X)

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Receptor Location	Predicted External Noise Level (dB)			Calculated Internal Noise Level (dB)		
	Daytime $L_{Aeq,16hr}$	Night-time $L_{Aeq,8hr}$	Night-time L_{AFmax}	Daytime $L_{Aeq,16hr}$	Night-time $L_{Aeq,8hr}$	Night-time L_{AFmax}
Southwest Façades						
Ground Floor	45	45	-	30 (✓)	30 (✓)	-
First Floor	45	45	-	30 (✓)	30 (✓)	-
Second Floor	46	45	-	31 (✓)	30 (✓)	-

Notes:
(✓) identifies that the target internal noise level is not exceeded.
(!) identifies that the target internal period noise level ($L_{Aeq,T}$) is exceeded by no more than 5 dB (refer to ProPG Guidance Note 7 of **Table 3.1**).
(X) identifies that the target internal period noise level ($L_{Aeq,T}$) is exceeded by more than 5 dB or the target maximum (L_{AFmax}) noise level is exceeded.

For flats and habitable rooms with windows in the southwest façades of the proposed building, there should be no restrictions to opening windows for ventilation or as overheating mitigation.

For flats with windows in the northeast façades of the proposed building, the target internal noise levels could be exceeded by up to 16 dB during the daytime and up to 19 dB during the night-time when windows are open for extended periods of time. All reasonably practicable design and ventilation mitigation needs to be considered and implemented to minimise the need to open windows for comfort cooling.

With reference to **Table 5.2**, it is recommended that a system 3 or 4 ventilation system is utilised for the proposed flats with habitable rooms overlooking the road and railway. System 3 and 4 use mechanical ventilation systems to continuously move air through the flats which can assist in mitigating overheating effects. System 4 ventilation systems (mechanical whole house ventilation with heat recovery) usually benefit from a summer by-pass mode which can provide a limited passive cooling effect. It may be necessary to consider additional means of cooling in addition to the typical ventilation requirements.

It should be noted that there will still be hot days of the year where windows will need to be opened for comfort cooling, however, due to the effects of high noise levels on sleep disturbance and other adverse health effects, the ventilation system should be designed to minimise the need to rely on open windows for comfort cooling to only a few hours of any day during overheating events. For those limited periods of time, open windows for ventilation are not considered to be an unreasonable form of overheating mitigation when balanced against the adverse consequences of overheating.

5.4. Plant Noise Assessment

It is not possible to carry out an assessment of plant noise as the precise requirements of the building are not detailed at this stage and any mechanical ventilation systems have yet to be determined. Additionally, as it has not been possible to obtain baseline noise measurement

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data at the site, typical background sound levels are unknown. If any externally mounted plant, a plant room or other significant sources of plant noise are ultimately proposed, an assessment in line with the RBC requirements and BS 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial noise* can be carried out at an appropriate time.

5.5. Recommendations to the Decision Maker

On the basis of the above and subject to the consideration and implementation of the noise mitigation recommendations, it is recommended that there should be no objection to granting planning consent for the proposed development on noise grounds.

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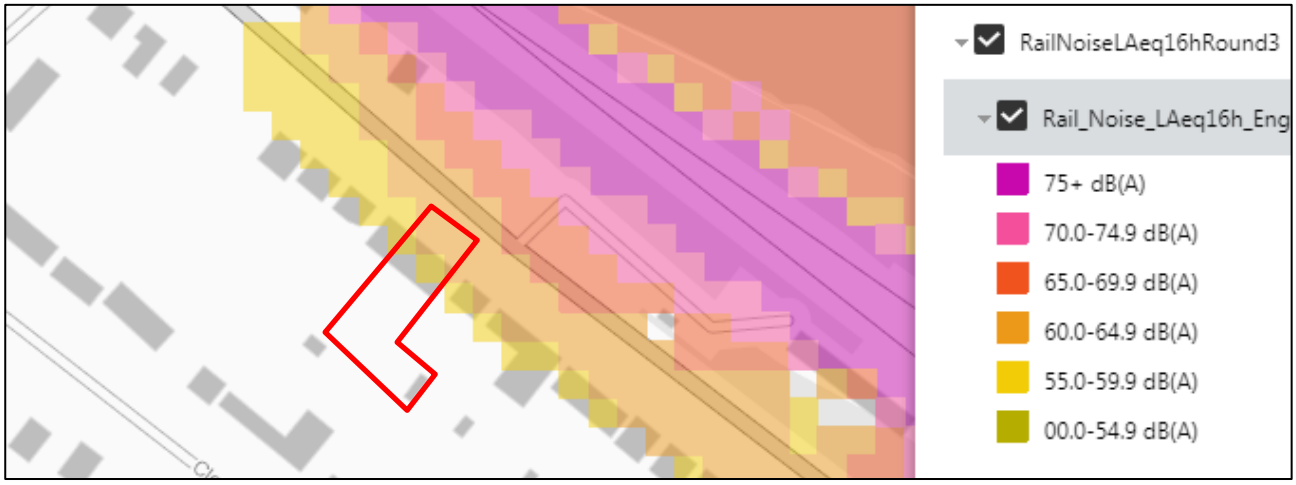
Figure F.1: Defra END Noise Map – Railway Noise $L_{Aeq,16hr}$



Retrieved 27th April 2020 from
https://environment.data.gov.uk/DefraDataDownload/?mapService=DEFRA/RailNoiseLAeq16hRound3&Mode=spatial

Figure F.2: Defra END Noise Map – Railway Noise L_{night}

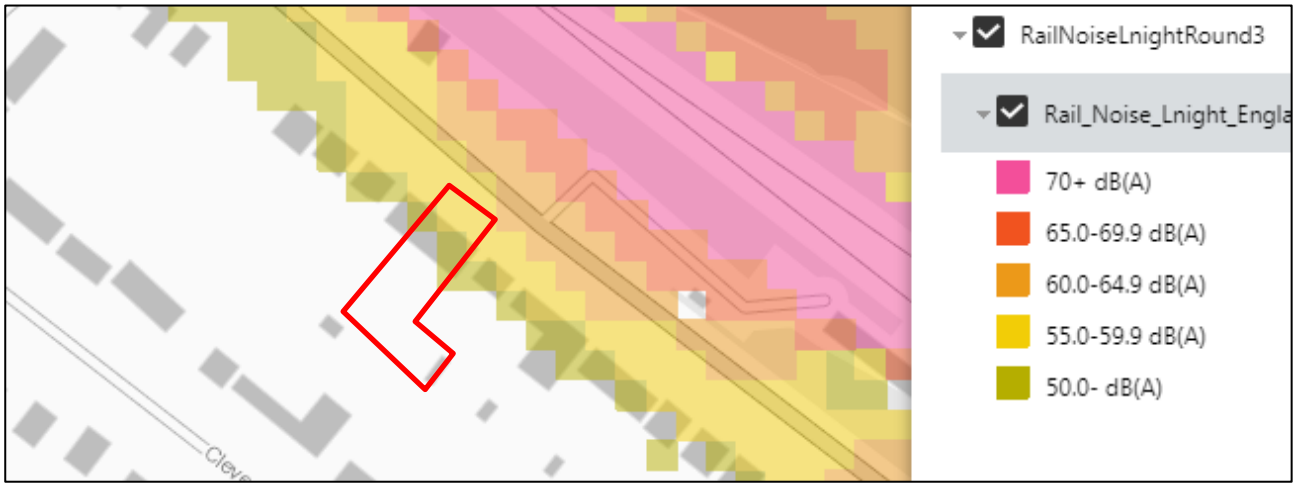


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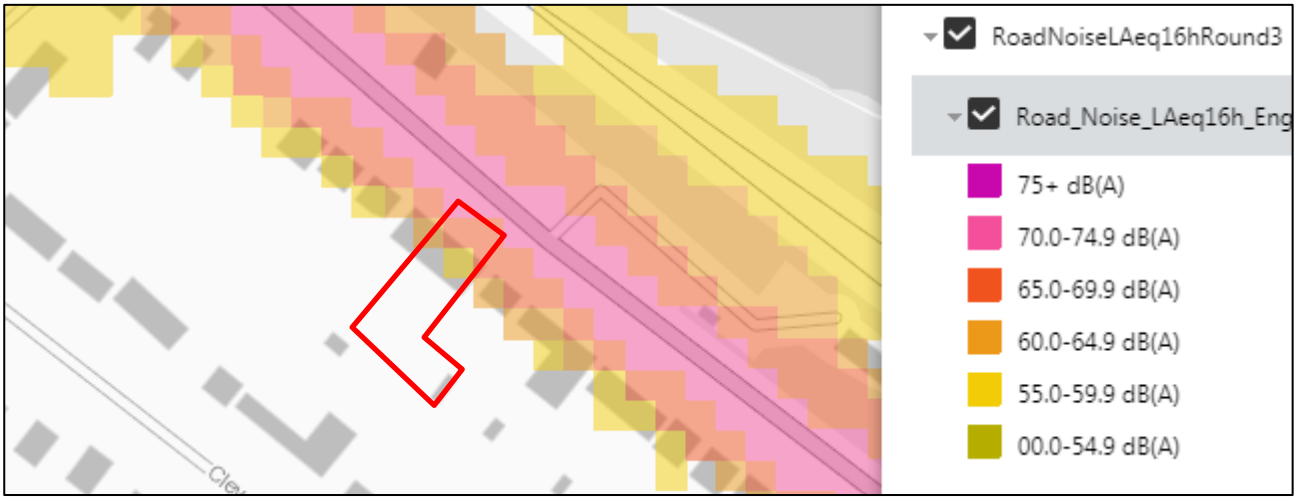
Figure F.3: Defra END Noise Map – Road Traffic Noise $L_{Aeq,16hr}$



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https://environment.data.gov.uk/DefraDataDownload/?mapService=DEFRA/RoadNoiseLAeq16hRound3&Mode=spatial

Figure F.4: Defra END Noise Map – Road Traffic Noise L_{night}

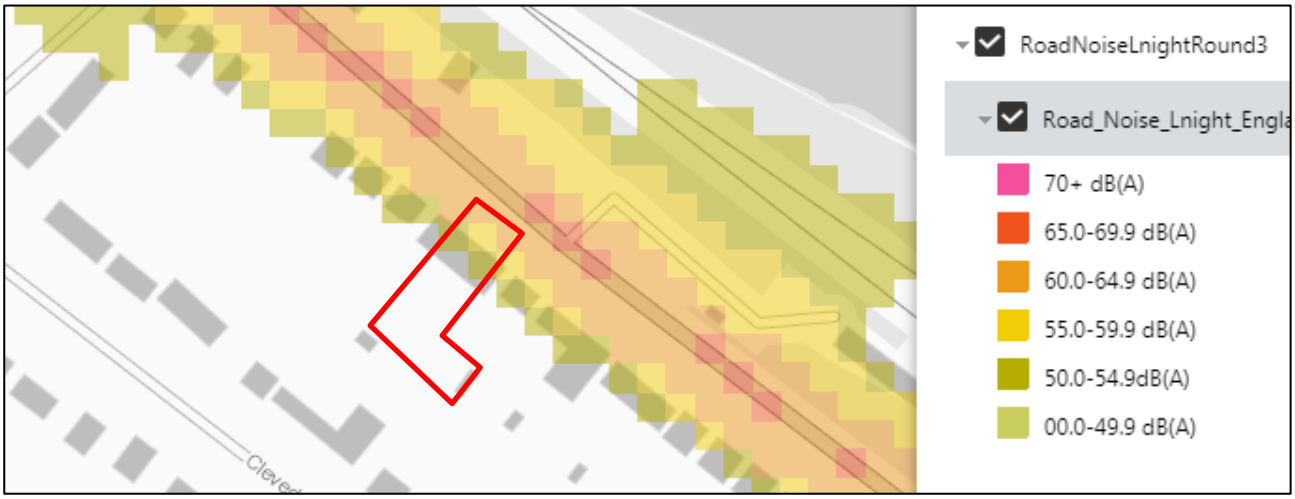

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Figure F.5: ProPG: Initial Site Noise Risk Assessment at Ground Floor Level

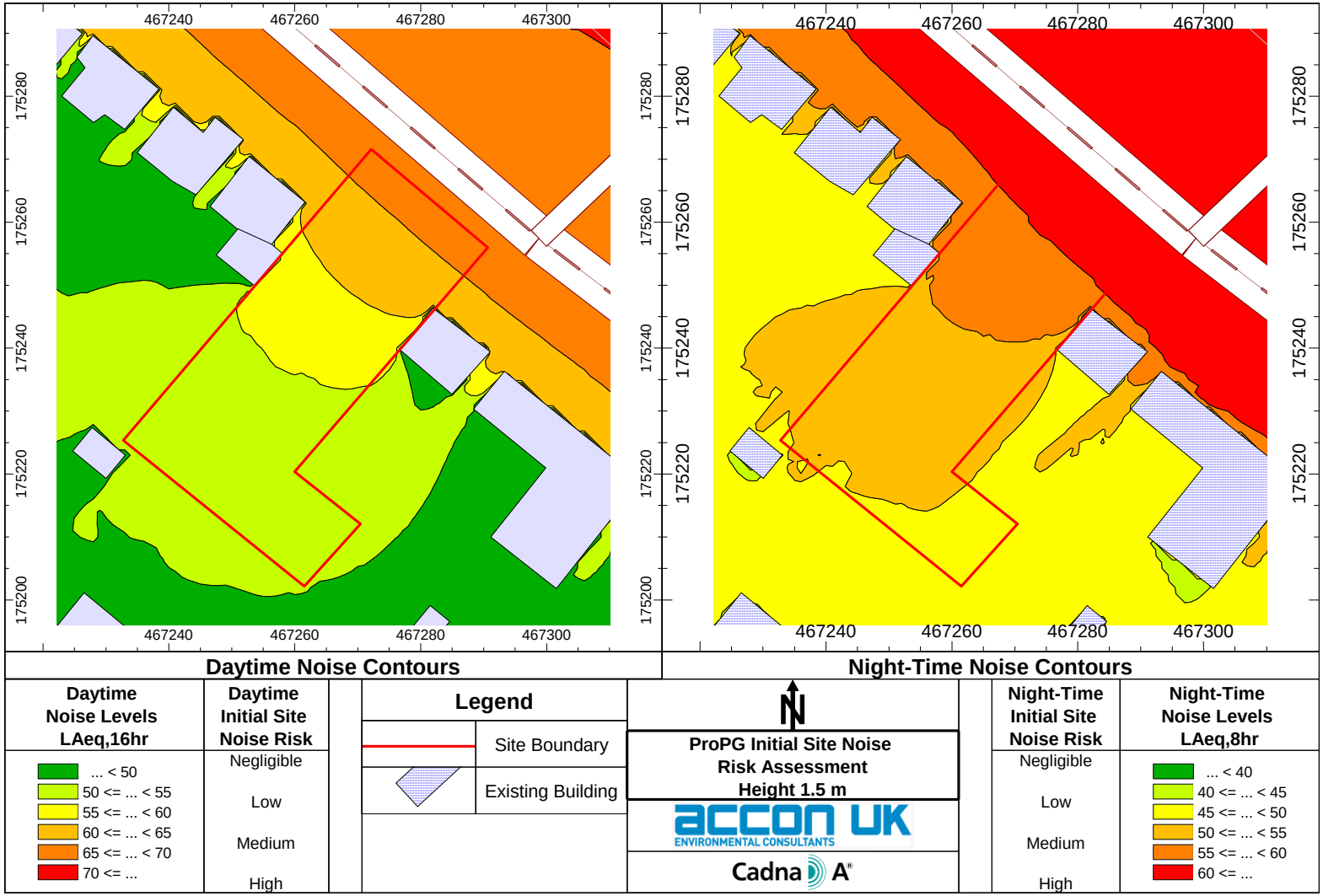

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Figure F.6: ProPG: Initial Site Noise Risk Assessment at First Floor Level

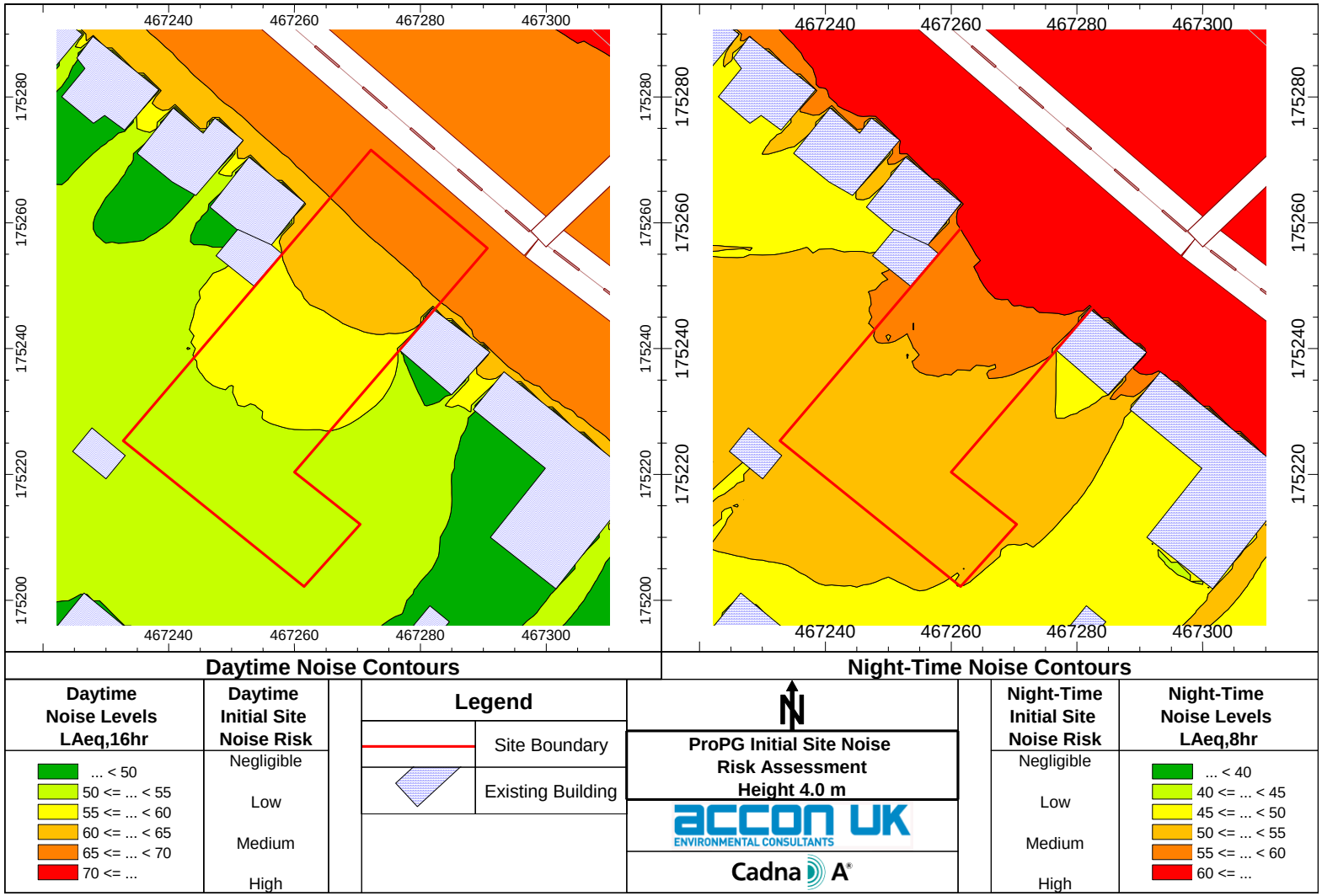

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Figure F.7: Proposed Ground Floor Plans

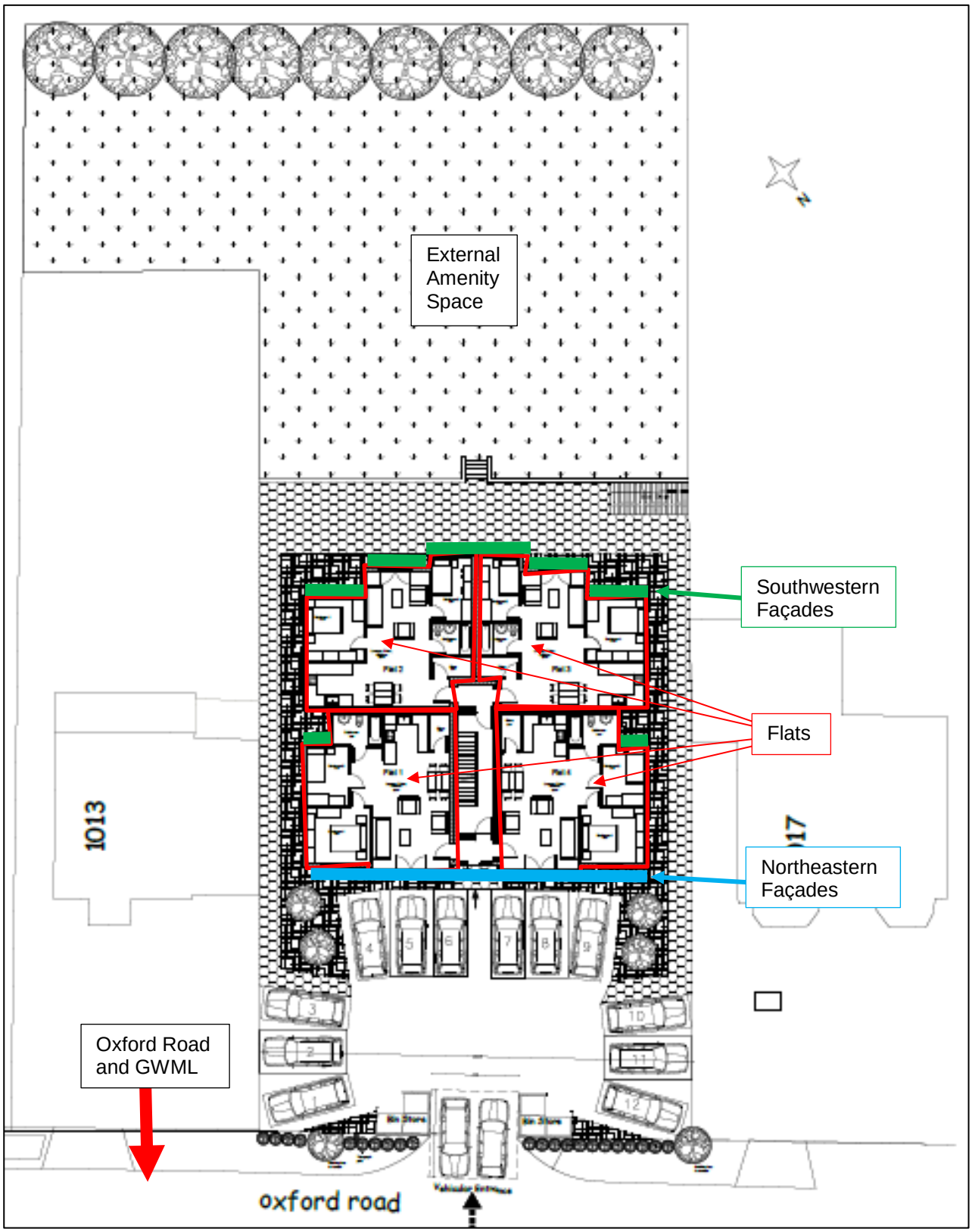

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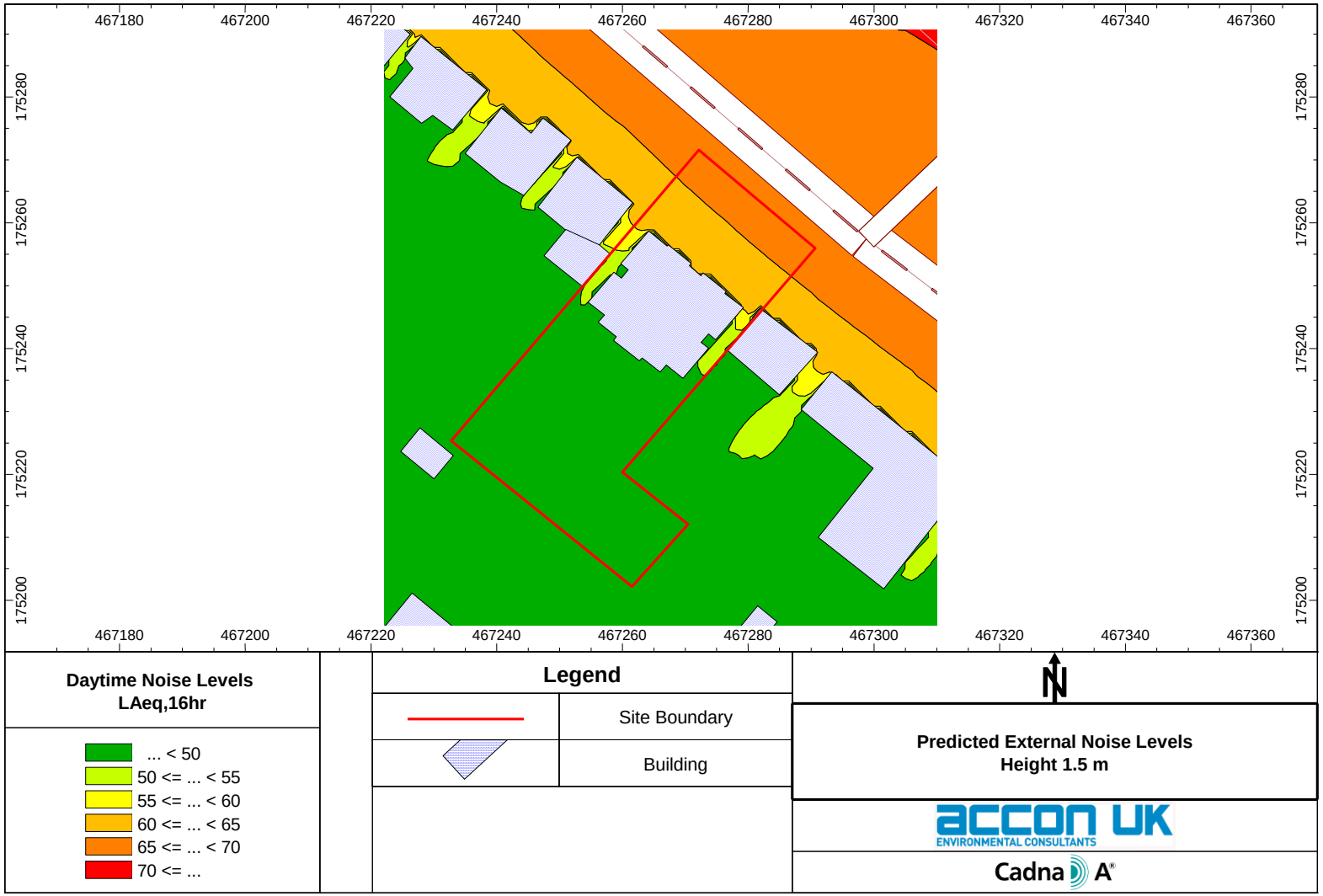
Figure F.8: Predicted External Noise Contours Height 1.5 m



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APPENDICES

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Appendix 1
Glossary of Acoustic Terminology

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Term	Description
'A'-Weighting	*This is the main way of adjusting measured sound pressure levels to take into account human hearing, and our uneven frequency response.*
Decibel (dB)	*This is a tenth (deci) of a bel. A decibel can be a measure of the magnitude of sound, changes in sound level and a measure of sound insulation. Decibels are not an absolute unit of measurement but are an expression of ratio between two quantities expressed in logarithmic form.*
Frequency	*Frequency is related to sound pitch; frequency equals the ratio between velocity of sound and wavelength.*
$L_{Aeq,T}$ *(Ambient /Period Sound Level)*	*The equivalent steady sound level in dB containing the same acoustic energy as the actual fluctuating sound level over the given period, T. T may be as short as 1 second when used to describe a single event, or as long as 24 hours when used to describe the noise climate at a specified location.* $L_{Aeq,T}$ *can be measured directly with an integrating sound level meter.*
$L_{A10,T}$ *(Road Traffic Noise Level)*	*The 'A'-weighted sound pressure level of the residual noise in decibels exceeded for 10 per cent of a given time. The* $L_{A10,T}$ *is used to describe road traffic noise levels at a particular location.*
$L_{A90,T}$ *(Background Sound Level)*	*The 'A'-weighted sound pressure level of the residual noise in decibels exceeded for 90 per cent of a given time. The* $L_{A90,T}$ *is used to describe the background noise levels at a particular location.*
L_{Amax}	*The 'A'-weighted maximum sound pressure level measured over a measurement period.*

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