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Napier Court, Reading

220428
Acoustics Planning Report

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Document Revision History			Ref	220428 Napier Court	
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Executive Summary

Couch Perry Wilkes Acoustics were appointed by Peveril Securities to provide a Noise Impact Assessment Report in support of a planning application for a proposed residential scheme at Napier Court, adjacent to Napier Road, Thames Quarter and the major rail lines east of Reading Train Station. The scheme comprises the construction of new 11 storey buildings to provide 576 residential dwellings. The Site currently accommodates three commercial buildings and associated car parking which are to be demolished and the Site repurposed.

A noise & vibration survey was undertaken by SRL Technical Services Ltd in August 2021. The noise survey established ambient and background noise levels around the Site. Noise monitoring results confirmed that the two dominant sources of noise upon the Site were Napier Road to the north and the Major rail lines to the south of the Site. Background noise levels comprised noise from the surrounding road infrastructure within the centre of Reading, rail traffic movements as well as contributions from surrounding developments.

Environmental Health at Reading Borough Council were consulted to provide their typical requirements for noise via email. They have since responded with their policy performance standards for the scheme for internal noise levels within dwellings, internal sound insulation between residential dwellings and non-residential uses and noise emission requirements for fixed items of plant.

An indicative assessment of noise ingress has been undertaken and guideline specifications developed for the sound reduction of the different façades of the development. Both Napier Road and the railway lines represent significant noise sources, with over 1100 rail traffic movements on a typical day including through night periods. Due to proximity to these sources the scheme is reliant upon the sound insulation performance of the building envelope to achieve the required internal noise levels. As such, background ventilation is to be provided by mechanical means.

Noise ingress assessments have also been undertaken in accordance with the requirements of Approved Document O and guidance contained within the Acoustics Ventilation and Overheating guide. From assessment, during the overheating ventilation condition bedrooms are to be ventilated via mechanical means and living rooms by openable windows.

Based on the measured background noise levels and industry best practice, external noise emission limits applicable to building services systems have been derived. These have been developed based on the advice within BS 4142. These should be used to form an appropriately worded planning condition and should form a basis for the building services systems noise emission design as the project progresses to the next phase.

1.0 Introduction

Couch Perry Wilkes have been commissioned by Peveril Securities to undertake a noise impact assessment for the proposed residential scheme at Napier Court, Reading. The Site is located in the centre of Reading, to the east of Reading Train Station. It is bounded by the main railway line to the south and Napier Road to the north.

The scheme comprises the construction of new 11 storey buildings to provide 576 residential dwellings. The development will include ancillary facilities for residents, with amenity space at roof level (part indoor and set back).

This report presents details of a noise impact assessment undertaken to determine measures to control noise breaking into the development and also being emitted from its building services systems. As part of this assessment, the following works were undertaken.

- A review of Reading Borough Council's (RBCs) typical requirements for noise via consultation with RBC Environmental Health to establish their noise emission and ingress criteria;
- A detailed review of site survey noise data obtained SRL technical Services Ltd;
- Specification of noise emission limits for new fixed building services plant to adhere;
- Predictions of noise ingress via the façade and ventilation systems; and
- Guidance on an outline strategy for the sound insulation of the building envelope.

A glossary of common acoustic terms is included within Appendix A and supporting information relating to Planning Policy and Standards is provided in Appendix B.

2.0 Criteria

Consideration has been given to relevant planning policy and regulations concerning the redevelopment and the Site. The National Planning Policy Framework (NPPF)¹, the Noise Policy Statement for England (NPSE)² and Noise Planning Practice Guidance³ provide a framework for how noise should be considered within planning system. Generally, noise policy and guidance give local Authorities flexibility to develop specific requirements appropriate to their area and the site in question.

The core aim of these documents is to avoid and reduce significant adverse impacts and other adverse impacts on health and quality of life. A more detailed overview of these documents is included within Appendix B of this document.

2.1 Local Planning Authority Guidance

RBC were contacted to determine their noise policies. They provided their typical requirements with regard to the following:

- External noise ingress limits/internal noise level limits within dwellings; and
- External noise limits resulting from new items of fixed plant.

The scheme itself shall be designed, specified and constructed so that the sound insulation performance of the structure and the layout of the dwellings are such that the indoor ambient noise levels do not exceed the values detailed in Table 4 of BS 8233:2014 and that the individual noise events do not exceed 45 dB $L_{A,max,F}$ more than 10 times a night. Where opening windows will lead to an internal noise level increase of 5 dBA or greater above BS 8233:2014 recommended internal levels, the scheme shall include provision of alternative mechanical ventilation with minimum performance equivalent to a mechanical heat recovery (MVHR) system with cool air bypass as an alternative means of cooling and ventilation. Noise from the system should not result in BS8233 internal levels being exceeded.

It's understood that the criteria outlined by Environmental Health are applicable during the background ventilation condition and not the overheating ventilation condition.

The Reading Borough Plan presents the following requirement, which should be adopted by the scheme at this stage.

EN17: NOISE GENERATING EQUIPMENT

Where noise generating equipment is proposed, the noise source specific⁶¹ level (plant noise level) should be at least 10dBA below the existing background level as measured at the nearest noise sensitive receptor.

Environmental Health at Reading Borough Council confirmed their typical standards for internal noise levels within dwellings, their response was as follows

The predicted specific sound level ($L_{Aeq,Tr}$) (with reference to BS:4142) as measured at a point 1 metre external to the nearest noise-sensitive facade shall be at least 10dB below the pre-existing background sound level, $L_{A90,T}$ when all plant/equipment (or any part of it) is in operation. The predicted rating level, $L_{Ar,Tr}$ (specific sound level plus any adjustment for the characteristic features of the sound) as measured at a point 1 metre external to the nearest noise-sensitive façade (habitable window of a dwelling) shall not exceed the pre-existing background sound level, $L_{A90,T}$ when all plant/equipment (or any part of it) is in operation.

¹ Department for Levelling Up, Housing and Communities (DLUHC) (2023); 'The National Planning Policy Framework', TSO.

² Department for Environment, Food and Rural Affairs (DEFRA) (2010); 'Noise Policy Statement for England', DEFRA.

³ Department for Levelling Up, Housing and Communities (DLUHC) (2019); 'Planning Practice Guidance website', DCLG. (<http://planningguidance.planningportal.gov.uk/>)

2.2 Design Criteria

The following criteria have been developed for both noise emission and noise ingress to the development.

2.2.1 Noise Emission from the Development

The following limits would apply to fixed items of standard plant equipment.

- The predicted Specific Sound Level ($L_{Aeq,Tr}$) at 1 metre external to the nearest noise-sensitive facade shall be at least 10dB below the pre-existing Background Sound Level, $L_{A90,T}$ when all plant/equipment (or any part of it) is in operation.
- The predicted Rating Level, $L_{Ar,Tr}$ at 1 metre external to the nearest noise-sensitive facade shall not exceed the pre-existing Background Sound Level, $L_{A90,T}$ when all plant/equipment (or any part of it) is in operation.

RBC do not have standardised requirements for noise generated by emergency plant equipment and commonly judge this upon a case-by-case basis. Due to the size of the residential scheme, emergency plant will be required to ensure the safe evacuation of the building and as part of the fire strategy for the development. For such residential schemes, it's common practice to have a separate noise emission criterion to the standard plant to allow the proper function of the equipment. For such emergency plant the commonly used standard is as detailed below and is recommended to be adopted by the proposed scheme.

- The predicted Rating Level, $L_{Ar,Tr}$ at 1 metre external to the nearest noise-sensitive facade shall not exceed a level 10 dB above the pre-existing Background Sound Level, $L_{A90,T}$ when all emergency plant/equipment (or any part of it) is in operation.

2.2.2 Noise Ingress from External Noise Sources

The following table details RBC's requirements for the combined impact of noise break-in via the building envelope and noise generated by any mechanical ventilation systems at design load. In addition, RBC stipulate a performance standard for maximum noise levels within bedrooms during the night-time as is common for residential schemes. The following table summarises RBC's internal ambient noise level criterion to be adopted by the scheme, it should be noted these requirements fall in-line with good practice guidance included within BS8233⁴, WHO⁵ and ProPG⁶.

Table 2.1: Noise Ingress Criteria

Organisation	Room Space	Internal Noise Level, dB	
		Daytime (07.00 – 23.00)	Night-time (23.00 – 07.00)
BS8233:2014	Bedrooms	35 $L_{Aeq,T}$	30 $L_{Aeq,T}$
	Living Rooms	35 $L_{Aeq,T}$	-
	Dining Rooms	40 $L_{Aeq,T}$	-
RBC	Bedrooms	-	45 L_{AFmax} (no more than 10 times per night)

Notes: In-line with guidance, RBC also permit a relaxation of the above criteria (Section 2.1) 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 time base for the daytime $L_{Aeq,16h}$ is 07:00-23:00 and for night-time $L_{Aeq,8hr}$ 23:00-07:00.

2.2.3 External Noise Ingress during Periods of Overheating

Modern dwellings can suffer from overheating during summer. There are many contributing factors that relate to this including the energy efficiency of new buildings, solar gains and internal occupancy levels. It is not always practicable to fully mechanically cool apartments during such periods, therefore alternative forms of overheating mitigation are often employed.

There are Building Regulations' Approved Documents and design guidance considering internal noise and overheating. The Acoustics, Ventilation and Overheating Guide⁷ (AVO) presents guidance on how to assess the risk to occupants from increased internal noise levels resulting from the mitigation of overheating.

The 2021 Approved Document O (ADO) of the Building Regulations also requires that the overheating design considers potential impacts of increased noise upon the reasonable enjoyment of the residence. The document provides internal noise levels resulting from external sources, at which, it would expect occupants to close windows to reduce ingress. In July 2022 the ANC and IOA issued an ADO draft compliance guide (ADO Guide)⁸ which outlines how the internal noise guidance within ADO should be applied and seeks to provide a method of demonstrating compliance to the Building Control Body of the noise constraints in ADO.

As such, the requirements of ADO take regulatory precedence over other guidance such as AVO or ProPG. The requirements of ADO and the methodology of the ADO Guide should form the basis for internal noise criteria during periods of overheating. ADO is focussed upon sleeping conditions within bedrooms during the night-time. These should be supplemented where appropriate by other guidance documents such as AVO.

The following figure summarises the requirements and guidance contained within ADO.

⁴ British Standards Institution (2014), BS 8233: 2014 Guidance on sound insulation and noise reduction for buildings

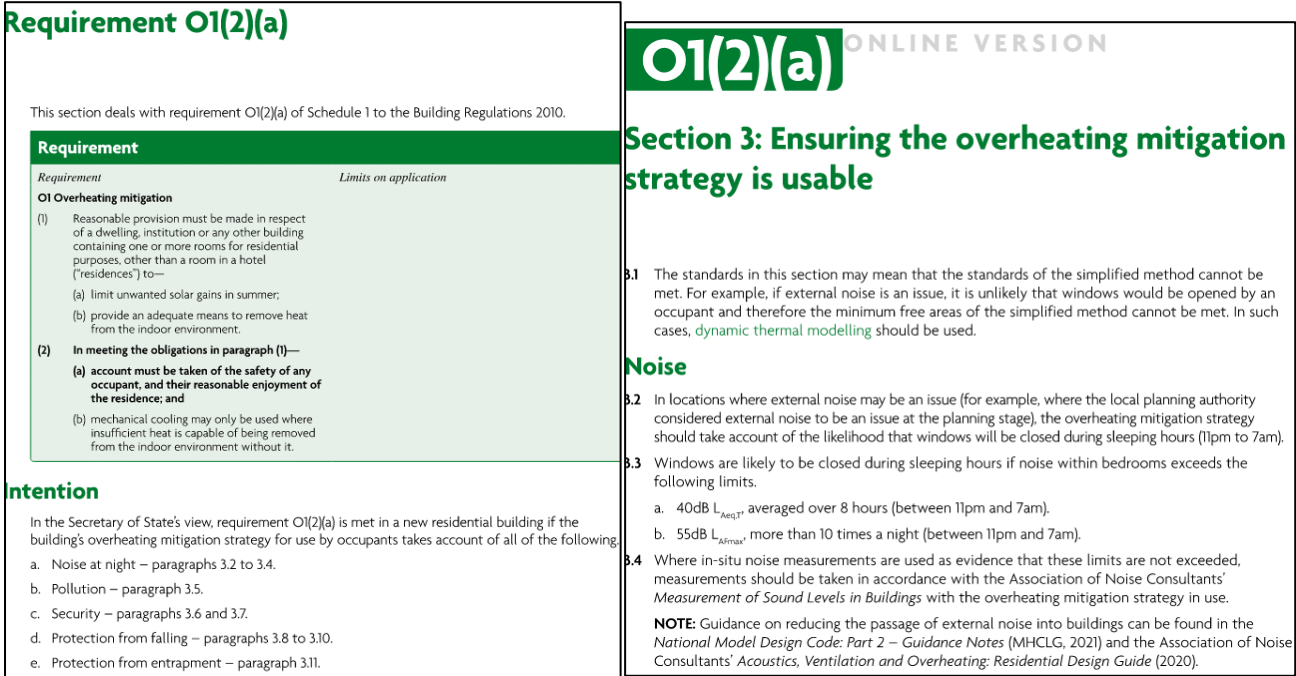
⁵ World Health Organisation (1999), Guidelines for Community Noise

⁶ ANC, IOA, CIEH (2017), Professional Practice Guidance on Planning & Noise, New Residential Development

⁷ Acoustics & Noise Consultants, (2018), Acoustics Ventilation and Overheating, Residential Design Guide

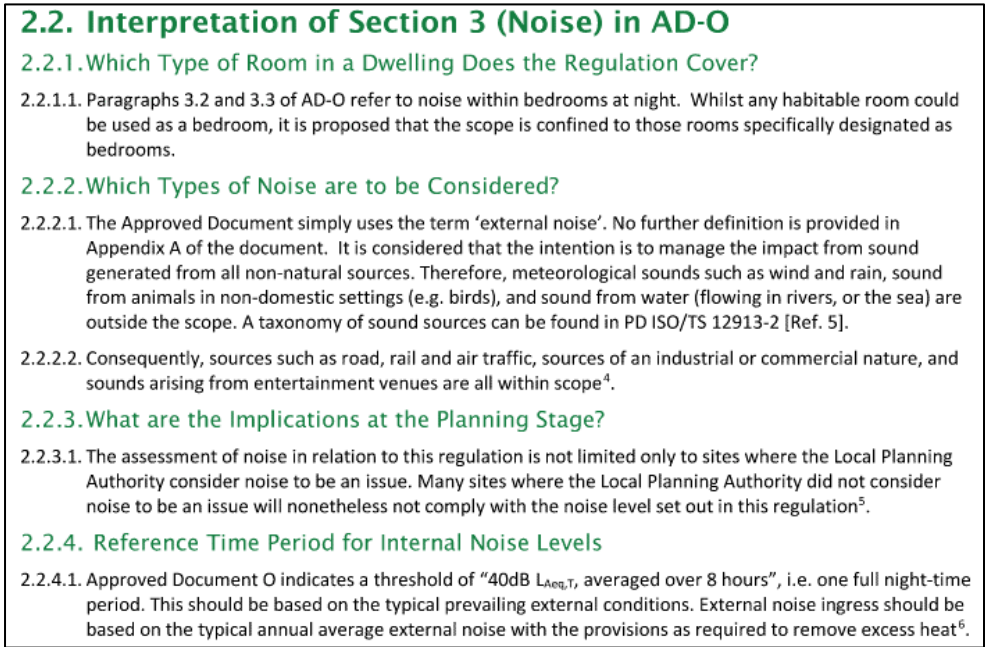
⁸ ANC & Institute of Acoustics (2022), Guide to Demonstrating Compliance with the Noise Requirements of Approved Document O

Figure 2.1: ADO Overheating Internal Noise Criteria



The ADO Guide issued by the ANC seeks to provide context to the above requirements, the following figure summarises the context.

Figure 2.2: ANC ADO Guide Interpretation of ADO



ADO defines minimum equivalent free areas for medium and high-risk locations as a ratio of the floor area, this is known as the simplified method when deriving equivalent free areas for cooling. The ADO Guide outlines that for such

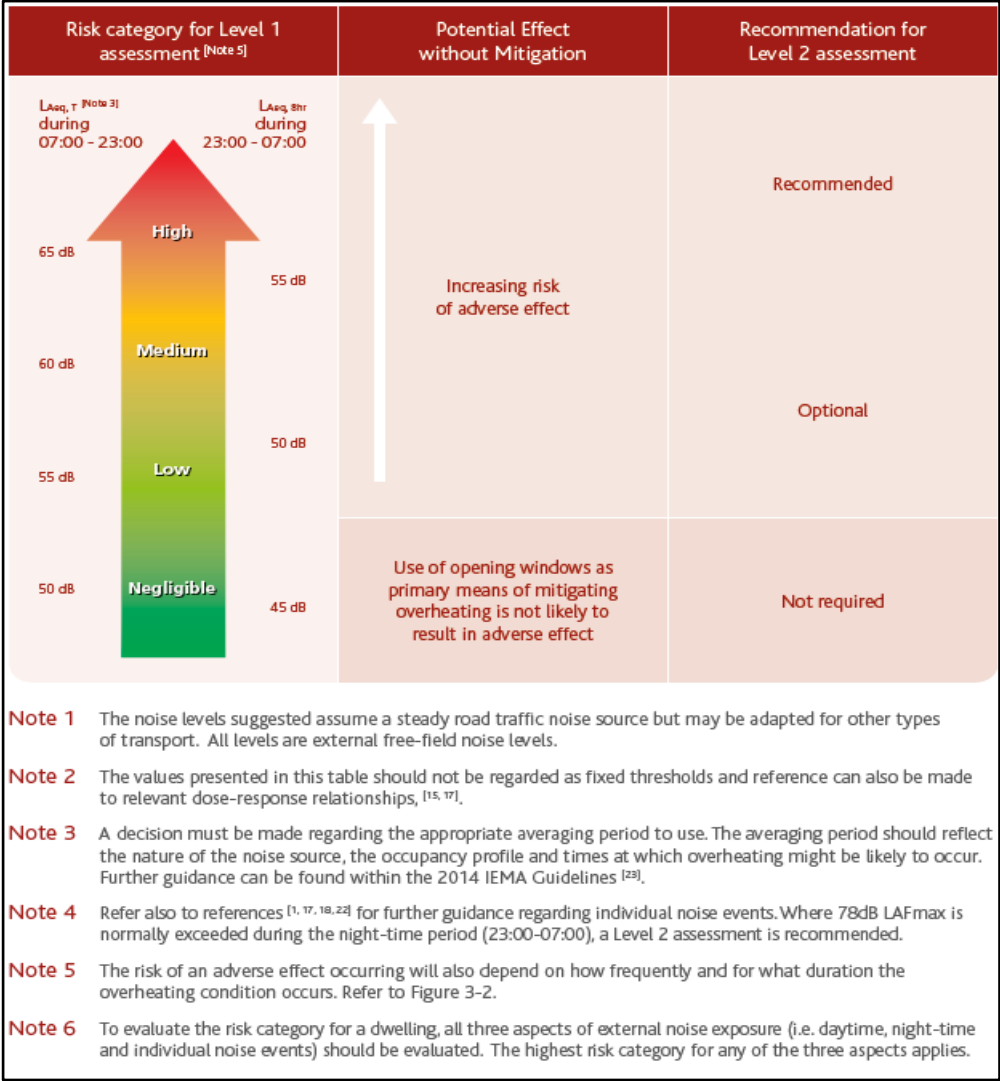
equivalent free area ratios, an outside-to-inside level difference for window openings of approximately 4 dB (high risk) and 9 dB (medium risk) would apply.

Using the above level differences, where an acoustic assessment indicates that the limits in Section 3.3 of ADO are likely to be exceeded with façade openings (windows/attenuated louvres) the standards of the ADO simplified method cannot be met and as such dynamic thermal modelling should be used.

ADO focuses on night-time sleeping conditions, consideration should also be given to daytime noise where external daytime noise levels are notably higher than the night-time noise environment.

The following figure presents the AVO Guide's Level 1 risk assessment and appraises daytime and night-time external noise levels.

Figure 2.3: AVO Guide Overheating Risk Assessment



2.2.4 External Vibration Ingress, Tactile Vibration

BS 6472-1⁹ presents a method for assessing the likelihood of adverse comment based upon exposure to vibration. The railway lines adjacent to the Site are considered a potential notable source of vibration. To categorise the level of

⁹ British Standards Institution (2008), BS 6472-1: 2008 Guide to evaluation of human exposure to vibration in buildings

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vibration exposure, BS 6472 presents a vibration dose value obtained from frequency weight vibration acceleration measurements.

The following table presents VDV ranges and the likelihood of adverse comment during the day and night-time periods. Below the described range of low probability, adverse comment is not expected.

Table 2.2: Noise Ingress Criteria

Period	Vibration Dose Value (m/s ^{1.75})		
	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Daytime (07.00 – 23.00)	0.2 – 0.4	0.4 – 0.8	0.8 – 1.6
Nighttime (23.00 – 07.00)	0.1 – 0.2	0.2 – 0.4	0.4 – 0.8

It's recommended that the scheme targets a low probability of adverse comment resulting from tactile vibration.

2.2.5 Vibration Induced Re-radiated Noise

RBC have not advised upon any specific criteria for vibration induced re-radiated noise. The following criteria are recommended to be adopted by the scheme and have been developed based upon project experience, and best practice guidance.

Table 2.3: Re-radiated Noise Limits in Dwellings

Period	Noise Limit
Daytime	35 dB L _{ASmax}
Night-time	35 dB L _{ASmax}
	45 dB L _{AFmax} ¹

Note: ¹This limit is cumulative based on external airborne noise ingress as well as vibration re-radiated noise

2.2.6 Party Walls, Floors and Ceilings to Back of House, Plant and Amenity Areas

Where apartments are vertically or horizontally adjacent to areas of different use Reading Borough Council advise the following from their typical requirements:

The scheme itself shall be designed, specified and constructed so that the sound insulation performance of the separating floor/ceiling between the uses achieves a minimum airborne sound insulation performance of greater than or equal to 55 dB (D_{ntw} + C_{tr}) and ensures that the noise levels within the property do not exceed the values specified in BS8233:2014 with appropriate penalties and adjustments for the character of the noise. The scheme shall make suitable provision for insulation from structure borne noise.

With due consideration of the above Reading Borough requirements, it's advised that for gyms, cinemas, loud plant rooms and the like the following minimum sound insulation performance standard is recommended.

- 60 dB D_{nT,w} + C_{tr}

For other non-residential uses such as general amenity, receptions, offices and the like the following minimum sound insulation performance standard is recommended:

- 55 dB D_{nT,w} + C_{tr}

With due consideration of RBC's requirement for noise transfer into apartments from areas of different use to not result in an exceedance of the BS 8233 internal noise criteria within apartments, it's considered necessary to target a level below the limit such that when contributions from other sources (external noise ingress, building services) are considered the overall limit is achieved. In addition, internal noise transfer from certain areas (cinema, gym etc.) are likely to be more transient and more disruptive. Therefore, noise transfer should be controlled to the following levels:

- Bedrooms 25 dB L_{Aeq} (07.00 – 23.00) when weighted across 31.5 Hz – 8 kHz
- Bedrooms 20 dB L_{Aeq} (23.00 – 07.00) when weighted across 31.5 Hz – 8 kHz
- KLDs 30 dB L_{Aeq} when weighted across 31.5 Hz – 8 kHz

3.0 The Site and Nearby Noise Sensitive Receptors

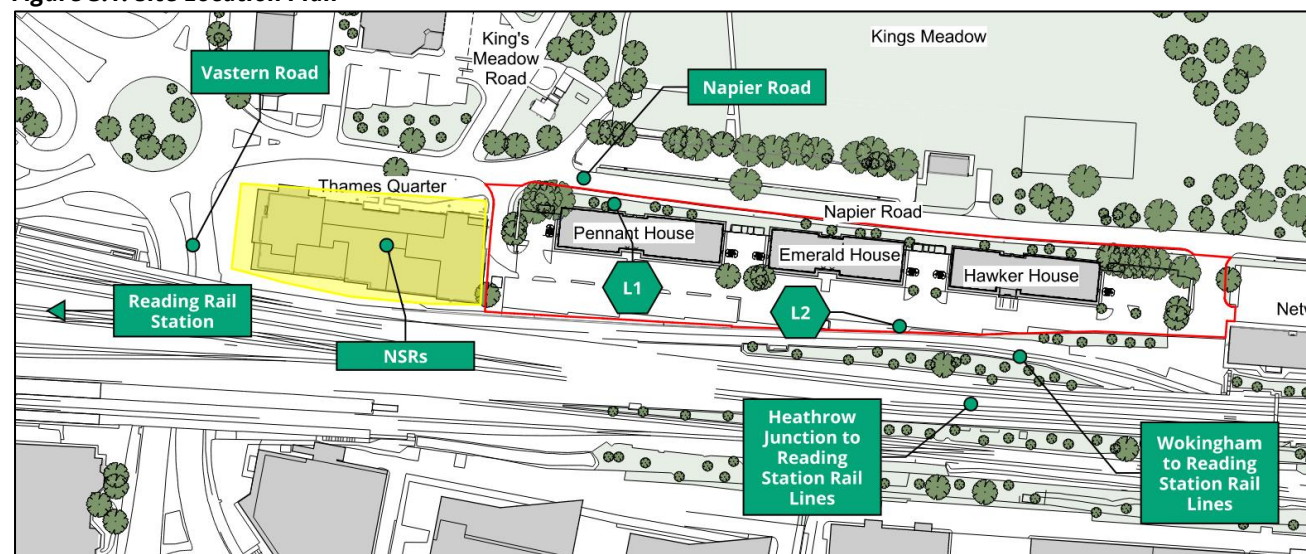
Full planning application for demolition of the existing three office buildings, and construction of new 11 storey buildings, with amenity space at roof level (part indoor and set back), to provide 576 residential dwellings consisting of 1, 2 and 3-bedroom apartments. The development will include ancillary facilities for residents, such as a residents' lounge, gym and communal workspace. The buildings will be set in landscaping to the front and between the buildings together with roof terraces. Parking is proposed for 39 cars and 6 motorbikes. Three internal storage spaces are proposed at ground floor for 289 bicycles and an additional 20 cycle spaces are provided externally for visitors. The site is 1.26 ha in size and stretches east to west along Napier Road, bound by the railway line to the south, Napier Road and Kings Meadow to the north, Thames Quarter to the west and a Network Rail site to the east. The site is located within the administrative boundary of Reading Borough Council and is very well connected to the train station, bus services and town centre facilities.

Napier Road and the adjacent railway lines represent the most significant sources of noise impacting the Site. Based upon the Network Rail working timetable (WTT) it's anticipated that on a typical day over 1100 train movements can be expected upon this section of track, including a significant proportion of movements throughout the night-time.

The Site is located adjacent to the existing Thames Quarter residential development, which is considered the nearest noise sensitive receptor, NSR. The Site is located in a mixed commercial, light industrial and residential area with access to open space to the north along the River Thames.

The following figure details the approximate Site Boundary in red, the nearest NSR in yellow and notable sources of noise.

Figure 3.1: Site Location Plan



4.0 Baseline Noise Survey

4.1 Method

CPW Acoustics were not commissioned to undertake noise & vibration surveys at the site. A historical noise & vibration survey had already been commissioned at the Site by the Applicant. The historical survey was undertaken by SRL Technical Services Ltd in August 2021. The data from this survey was provided to CPW Acoustics for review and assessment. This section provides a relevant summary of the survey information obtained from SRL.

A site visit was undertaken 10th – 11th August 2021 by SRL. The collected survey data was used to establish the existing ambient noise levels around the Site and the background noise environment at a location representative of the nearest noise sensitive receptor.

Survey conditions are understood to have been generally appropriate with wind speeds below 5m/s and temperatures between 10 -22°C. More detailed survey information was presented in report 80081-SRL-RP-YA-01-P1 which can be provided upon request.

We consider the noise and vibration data to be robust and acceptable for use in this assessment.

On review of the site area, the dominant noise sources are considered to be the rail lines leading to/from Reading Rail Station and Napier Road. With such transportation sources significant changes in movement quantity are required to yield notable changes in external noise levels across the Site. For example, to yield a just perceptible change (for a person with normal hearing sensitivity) in noise level $\pm 3\text{dB}$, the amount of road or rail traffic movements would have to double or halve. It is not anticipated that such significant changes in road/rail traffic will have occurred since 2021 and any changes that may have occurred are anticipated to yield negligible changes to the noise environment.

4.2 Noise Monitoring Locations

The noise monitoring locations undertaken by SRL are illustrated in Figure 3.1. Measurements were undertaken over two consecutive days with one full night period. Due to the frequency of rail traffic movements, it's anticipated that noise levels across the Site will be consistent between typical weekdays, with some reduction over weekend periods.

Measurement Location, L1, screened from the railway lines captured noise levels resulting from Napier Road as well as background sound levels at Thames Quarter. To the East along Napier Road is a large Tesco Extra which is understood to dominate road traffic movements past the Site. Measurement Location, L2 captured noise levels resulting from the railway lines.

4.3 Results

A summary of the noise monitoring data is presented in the following table. A copy of the full measurement data can be provided upon request, measurements were taken in free-field conditions. It's understood that for measurement location L1, road traffic movements along Napier Road dominated maximum and ambient noise level measurements. For location L2, rail traffic movements dominated ambient and maximum noise levels. Due to the number of rail tracks and their relative distance to the Site, more variance in maximum noise events is observed depending upon which track the rail movement occurred. These sources as well as the wider road network also dominated background noise level measurements across both positions.

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Table 4.2: Noise Survey Results

Location	Date	Time Period	dB LAeq, T range (Average ¹)	dB LA90, T range (10 th Percentile ²)	dB LAFmax, T range (10 th Highest ³)
L1	10 – 11/08/2021	Daytime (07.00 – 23.00)	63 – 70 (66)	42 – 63 (45)	N/A
		Night-time (23.00 – 7.00)	39 – 64 (59)	36 – 45 (37)	70 – 84 (79)
L2	10 – 11/08/2021	Daytime (07.00 – 23.00)	63 – 70 (66)	42 – 46 (44 ⁴)	N/A
		Night-time (23.00 – 7.00)	39 – 65 (58)	36 – 42 (36)	54 – 90 (79)

Note: Supplied data was recorded every 15 minutes, with a fast time weighting. ¹ Logarithmic average over the given time period. ²The reported LA90 figures are the 10th percentile over the given time period and are representative of the typical lowest background noise level. ³The reported LAFmax values are the 10th highest 15-minute night-time maximum levels deemed appropriate due to the presence of only 1 notable noise source in the area. ⁴The reported daytime value is the modal average over the surveyed evening period (19.00 – 23.00) due to partial daytime survey data (15.00 – 23.00), where the 10th percentile is not considered representative of typical lowest daytime background sound levels.

To provide context to the above values, time history overviews of the noise measurements are presented in the following figure.

Figure 4.1: Measurement Location L01 Time History

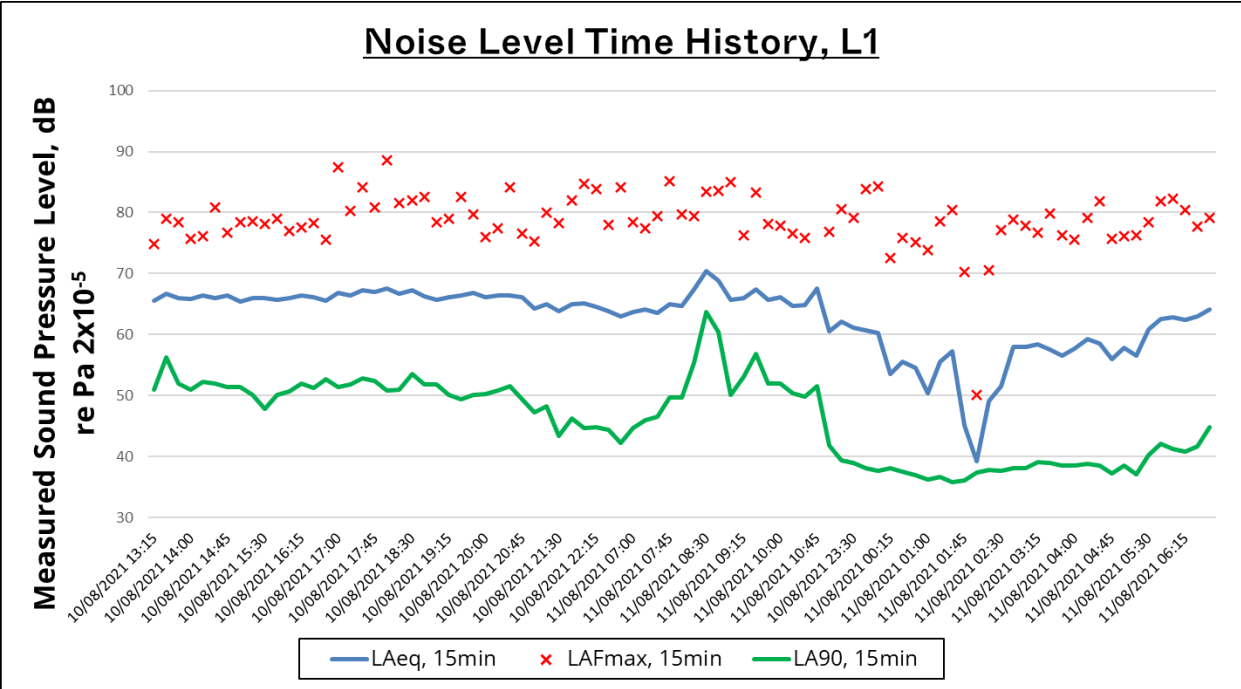
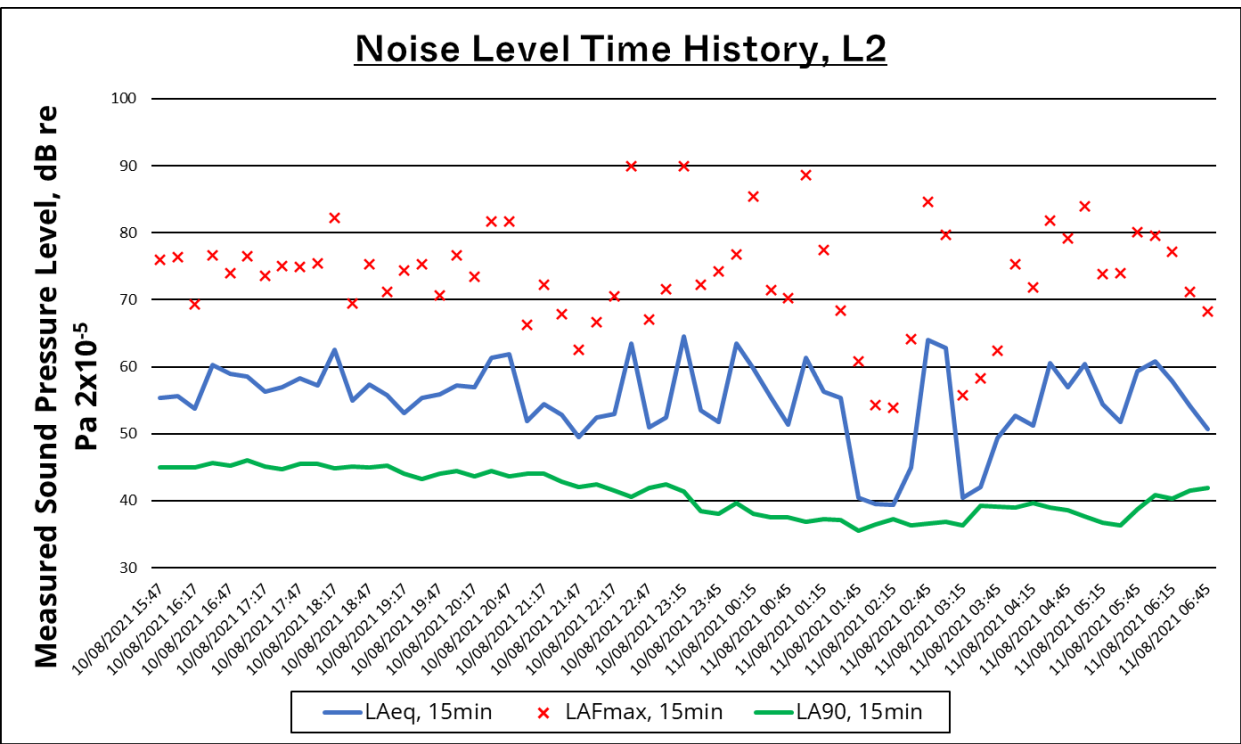


Figure 4.2: Measurement Location L2 Time History



The following table presents a summary of the vibration monitoring data collected at location L2. It's understood that rail traffic movements were the primary cause of measured levels of vibration and it's anticipated that rail movements along the closest line produced the most significant vibration events.

Table 4.3: Measured Vibration Dose Levels

	Day	Night
Measured Vibration Dose Value (VDV)	0.11 ms ^{-1.75}	0.11 ms ^{-1.75}

SRL provided their vibration survey data for analysis. With regard to the available acceleration data, the format and detail available for analysis is limited. Acceleration data was provided in the form of 15-minute measurement files and 1/1 octave band data. Tri-axial simultaneous measurements were taken, in the x, y and z axes in reference to ground level.

SvanPC++ 3.4.15 was used to extract the acceleration data. RMS and maximum values were obtained for the 15-minute periods. The following tables present representative worst-case 15-minute samples. It's unclear if the measurements were captured with a fast or slow time response.

Table 4.4: Representative Ground-borne Vibration Acceleration RMS levels

RMS Acceleration Vibration Level, ms ⁻² per Octave Band Centre Frequency Hz						
8	16	31.5	63	125	250	500
0.000371108	0.000461318	0.000501765	0.000448745	0.00035156	0.000267301	0.00022182

Table 4.5: Representative Ground-borne Vibration Acceleration L_{max} levels

L _{max} Acceleration Vibration Level, ms ⁻² per Octave Band Centre Frequency Hz						
8	16	31.5	63	125	250	500
0.001282	0.001434	0.001085	0.000920	0.000626	0.000389	0.000293

5.0 Assessment

The following section presents an assessment of the external noise levels in conjunction with the proposed development and the internal noise criteria. This assessment should be regarded indicative only and a detailed assessment will be required in due course based on more developed designs.

5.1 External Noise Ingress

Based on the noise levels obtained during the survey, the levels of noise incident upon the different façades of the development have been predicted using computer modelling software Cadna (A). Calculation have been based on the elevation and general arrangement drawings issued in March 2024.

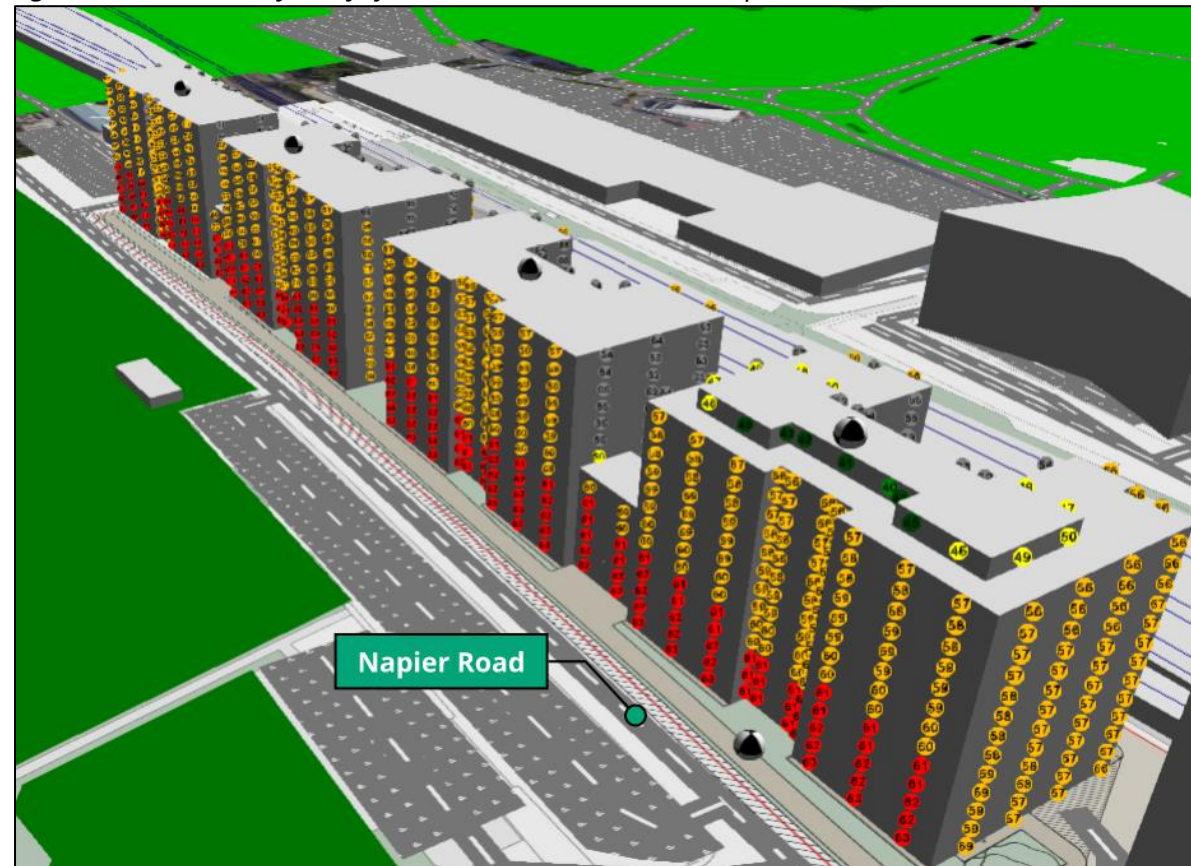
The following table summarises the predicted noise levels incident on the major façades of the development. Figure 5.1 represents the 3D modelling output for daytime ambient noise levels.

Table 5.1: Summary of predicted façade incident noise levels

Façade Location	Time Period	dB L _{Aeq}	dB L _{AF,max}
Napier Road	Daytime (07.00 – 23.00)	57 – 63	n/a
	Night-time (23.00 – 7.00)	50 – 55	72 – 78
Railway Facing	Daytime (07.00 – 23.00)	53 – 59	n/a
	Night-time (23.00 – 7.00)	53 – 59	76 – 81

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Figure 5.1: Predicted daytime façade incident noise levels, dB L_{Aeq}



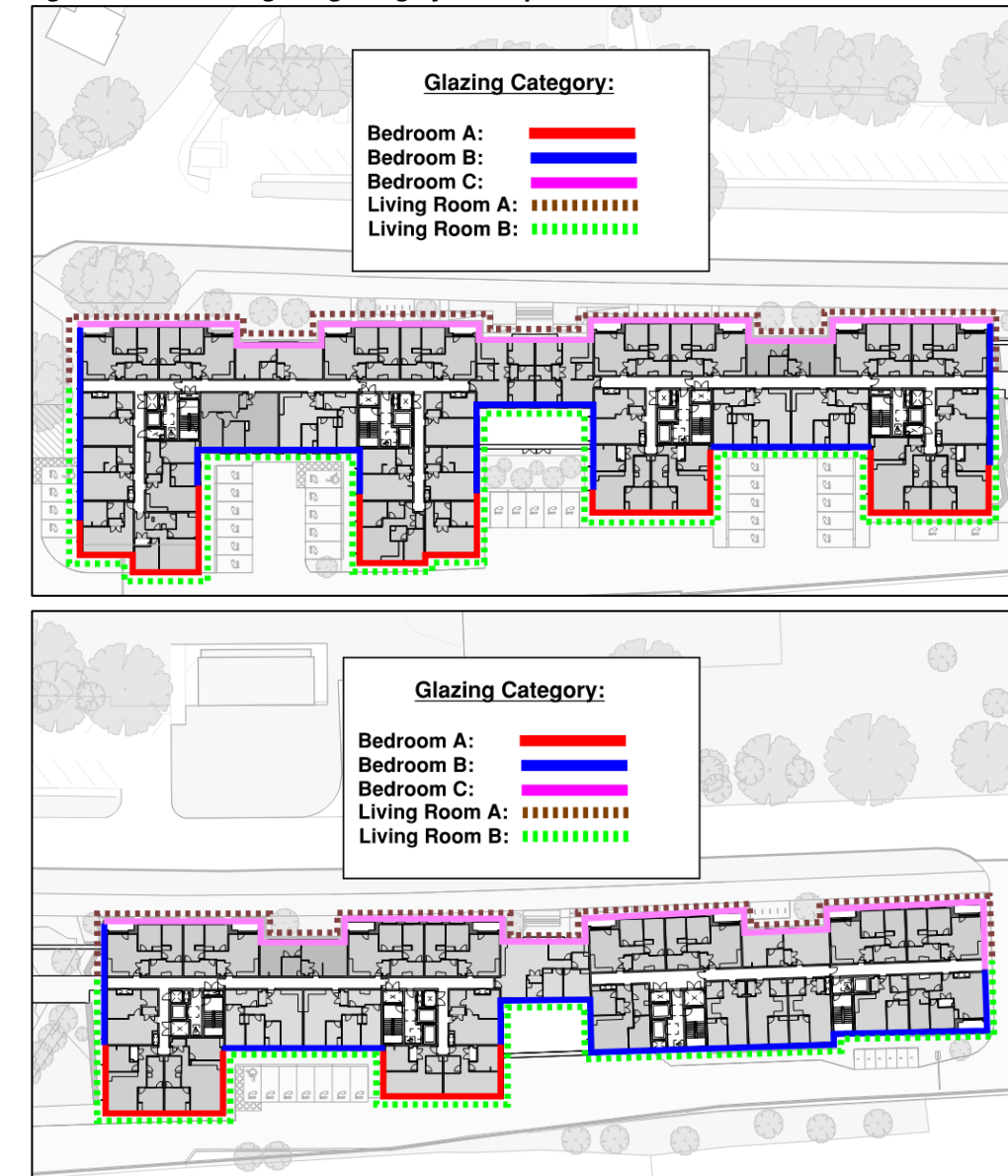
5.1.1 Background Ventilation Condition

Based on the 3D model predictions, calculations of noise ingress have been undertaken to determine the sound reduction requirements applicable to the façade and ventilation systems. Calculations have been undertaken in general accordance with the methodology of BS 8233 and corrections have been applied to account for the nature of the noise source. The purpose of the calculations is to demonstrate the type of ventilation and façade sound reduction strategies that are considered appropriate for the proposed scheme.

Bedrooms are more sensitive to noise and as such drive the more onerous glazing/ventilation specifications throughout the scheme. However, for completeness specifications have also been provided for kitchens/living rooms (KLDs) in order to illustrate the minimum requirement for each room type. The size of external glazing varies depending on the bedroom in question, worst case bedrooms were selected for assessment which have the largest glazing areas (3.5m²) and are exposed to the highest external noise levels.

The following figure presents the developed sound insulation categories for external glazing per major façade. Two categories are presented for each façade, one for bedrooms and one for KLDs.

Figure 5.2: Predicted glazing category markup



Sound insulation performance specifications have been derived for the glazing categories presented in Figure 5.2 and are described within the following table. The architect has suggested the likely overall façade build-up will comprise:

- Plasterboard lining
- Insulated SFS zone including CP board
- Insulation
- Mechanically fixed brick slips
- Likely 500mm build up in total
- A solid operable louvre door will comprise part of the facade

A solid operable louvre door will be used in living and bedrooms to provide purge ventilation only. At this stage the details of the louvre door system have not been developed however, it will be designed so that the overall composite sound insulation of the facade achieves the sound insulation specification shown in Table 5.2.

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The following table presents the minimum sound insulation performance specifications for the external glazing and solid elements of the façade. It should be noted that the glazing performance specifications are for a full system including framing, seals and ironmongery. **Where suppliers provide glass only data it will be necessary to select glazing with performance in excess of the below**, this amount varies depending upon the framing in question but is typically in the order of + 3dB. Indicative glazing build-ups have been provided to allow initial costing at this stage, however, suppliers should confirm proposed systems are capable of meeting the performance requirements and not the build-ups.

Table 5.2: External Façade Minimum Sound Insulation Performance Specifications

Façade Category	Minimum Octave Band Sound Reduction Indices, R dB								Indicative Glazing Build-up (based upon saint gobain data)
	63	125	250	500	1k	2k	4k	8k	
Glazing Bedroom A	25	34	36	41	40	44	52	55	12(24)12.8A
Glazing Bedroom B	22	28	29	36	43	46	54	50	12(12)8.4A
Glazing Bedroom C	20	30	31	36	37	42	54	55	10(12)16.8
Glazing Living Room A	25	21	24	32	37	33	41	41	10(15)6
Glazing Living Room B	21	18	24	30	39	33	43	47	8(16)6
Solid Façade and Operable louvre door	27	40	50	50	53	55	63	63	See Below

These specifications are provided to allow flexibility when selecting glazing systems. It should be noted that the performance specifications for railway facing glazing systems are considered onerous and will require heavy laminated double glazing with a notable cavity size.

Performance specifications are developed based upon the noise level incident upon the façade in question, the façade area to room volume ratio and the sound insulation performance of the individual elements. Glazing is commonly the weakest element and limits the extent of noise ingress. Where glazing areas are large, it's necessary to increase their performance.

The 500mm thickness allocated to the external façade is considered sufficient to achieve the above noted sound insulation performance specifications. The following acoustic design elements will be necessary to achieve the above necessary performance specifications and will need to be developed in detail in due course:

- The internal SFS framing should be fully independent of the sheathing board and external elements;
- The internal lightweight lining will be required to have reasonable mass layers, akin to 2 x 15mm SoundBloc or similar.

5.1.2 Overheating Ventilation Condition

Internal noise levels within dwellings during periods of overheating should achieve the performance standards contained within Approved Document O, outlined below.

Figure 5.3: ADO guidance during the overheating ventilation condition for bedrooms

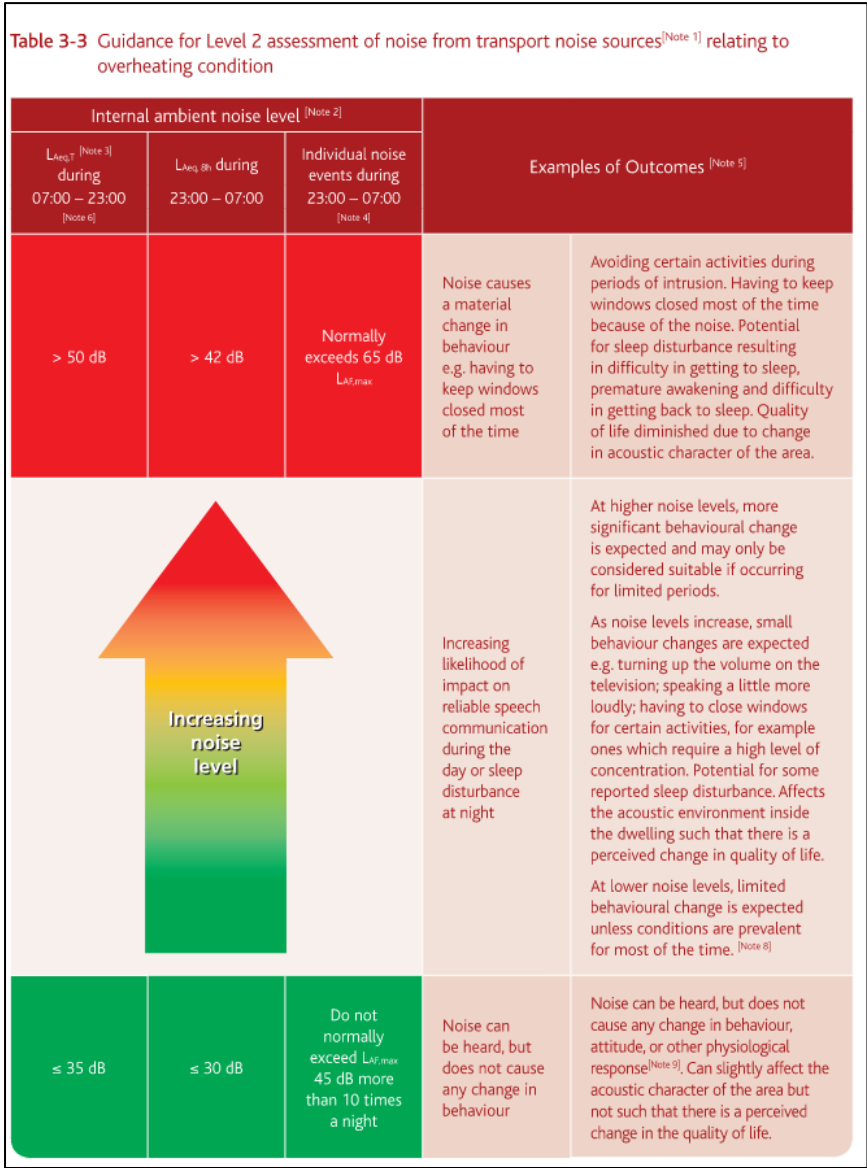
Noise	
3.2	In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).
3.3	Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits. a. 40dB $L_{Aeq,T}$ averaged over 8 hours (between 11pm and 7am). b. 55dB L_{AFmax} more than 10 times a night (between 11pm and 7am).

The above criterion presented within ADO is applicable to bedrooms. Sleeping/resting conditions within dwellings are considered the most onerous demand upon internal ambient noise levels.

Using methodology from the ADO Guide, to achieve 40 dB $L_{Aeq, 8hours}$ internally at night during periods of overheating for a 'medium risk' apartment, external noise levels should not exceed 49 dB $L_{Aeq, 8hours}$. As can be seen in Table 5.1, façade incident noise levels exceed these values during the night-time. In-line with ADO advice, openable windows within bedrooms are not considered appropriate (for the purposes of overheating mitigation, openable windows should still be provided for residents to provide a connection to the outdoors). The currently proposed ventilation strategy to mitigate overheating within bedrooms is to utilise an increased ventilation rate through the MVHR system.

ADO is not applicable to kitchen/living rooms (KLDs). There is good practice guidance available for overheating within dwellings, *Acoustics, Ventilation and Overheating, Residential Design Guide* (AVO 2021) which provides guidance relating to the acoustic impact of elevated internal noise levels during periods of overheating. The following figure presents the AVO guidance/resulting outcomes for internal ambient noise levels during the overheating condition.

Figure 5.4: AVO guidance during the overheating ventilation condition



In-line with this guidance, internal noise levels within KLDs resulting from external transportation noise should be kept below **50 dB L_{Aeq}** where practical. The AVO Guide and ADO Guide both provide advice upon the level difference that can be expected through a partially open window. A level difference of between 4 dB (fully open) and 13 dB (partially open) can be expected through an open window depending upon the opening area and room size. A 13 dB reduction equates to an opening area equal to 2% of the floor area, for a room of 30m² this equates to an area of 0.6m².

The reported façade noise levels in Table 5.1 and Figure 5.1 show daytime noise levels are higher for the Napier Road facing rooms. Due to their northerly orientation such rooms are expected to experience reduced levels of overheating. From Ground Floor to Level 4, it's recommended that KLDs utilise increased ventilation rates to mitigate overheating in combination with small window openings where necessary. For Level 5 and above openable windows are considered appropriate for the mitigation of overheating.

For other elevations, openable windows are appropriate for as a means of overheating mitigation for KLDs.

During detailed design acoustic studies should be undertaken to confirm the overheating ventilation strategy for each habitable room.

5.1.3 Tactile Vibration

This section of the report discusses the measured levels of perceptible vibration resulting from train movements along the railway lines. Table 2.2 of this report details the best practice guidance for the probability of adverse comment as contained within BS 6472-1 resulting from vibration.

A summary of the worst case VDV values collected at site by SRL Ltd is presented in Table 4.3. Assuming the proposed development does not incorporate any vibration mitigation it can be seen that the measured VDV values fall below/within the range for low probability of adverse comment within dwellings. Therefore, no additional mitigation is considered necessary to mitigate the impacts of tactile vibration.

5.1.4 Vibration Ingress

The available vibration survey data is limited in its application to the assessment of vibration induced re-radiated noise. This section seeks to use the available data to establish the likely levels of noise ingress resulting from vibration induced re-radiated noise.

To determine the noise level resulting from vibration within the building, the level of vibration ingress was estimated. Transfer corrections were applied to the datum to determine the amount of energy that will travel from the foundations into the different levels of the superstructure, known as floor-to-floor losses.

Amplification corrections based on the predicted structural make-up have also been applied to the datum to give an estimation of the level of amplification from the floor structure which is based on the driving frequencies of the source, the size of the floor and its material properties.

Industry standard empirical formulae have been used to develop predictions of vibration levels within the buildings. These formulae have been taken from the following:

- *A Prediction Procedure for Rail Transportation Ground-borne Noise and Vibration – Nelson 1987*
- *Handbook for Urban Noise and Vibration Control – Saurenman, Nelson, Wilson*

The proposed scheme includes residential apartments at ground floor level, and therefore only the structural losses through the building foundations are included. Predictions have been based upon the structure comprising concrete with deep piled foundations.

Table 5.3 presents the worst case re-radiated noise levels predicted in the lowest most exposed apartments. Apartments in upper levels will have lower predicted re-radiated noise levels. It should be noted, that the below predictions are considered worst-case by selecting the highest RMS and L_{max} values. The L_{max} values over a 15-minute period are anticipated to represent the maximum value in each octave that was measured rather than a representative maximum spectrum recorded for a vibration event assuming more than one vibration event in a 15-minute period. It's expected that there would typically be more than 10 rail traffic movements per hour.

Table 5.3: Predicted Re-Radiated Levels

RMS, Predicted Approximate Re-radiated Noise Level dB L_{Amax}	L_{max} Predicted Approximate Re-radiated Noise Level dB L_{Amax}
18	24

The above predictions are illustrative only, due to the limitations afforded by the captured acceleration data. Based upon the available data, it's expected that vibration induced structure-borne re-radiated noise will fall well below the limits presented within Table 2.3, and therefore further study/assessment at this stage is not considered necessary.

5.2 Operational Plant Noise Limits

Based upon the measured background noise levels and the proposed noise emission criteria as stipulated in Section 2, the following Tables present the derived plant noise limits.

Table 5.4: Building Services Plant Noise Limits

NSR (See Figure 3.1)	External Plant Specific Level Limit During Plant Operating Period, $L_{Aeq, Tr}$ (dB)	
	Daytime (07.00 – 23.00)	Night-time (23.00 – 7.00)
Thames Quarter	35	27

Table 5.5: Emergency Plant Noise Limits

NSR (See Figure 3.1)	External Plant Rating Level Limit During Plant Operating Period, $L_{Ar, Tr}$ (dB)	
	Daytime (07.00 – 23.00)	Night-time (23.00 – 7.00)
Thames Quarter	55	47

5.2.1 Proposals

At this stage, details of the building services systems are not developed to the point where a meaningful assessment of their noise emission can be undertaken. However, the limits serve as a design basis upon which future assessments and plant specifications can be made.

The extent of external plant is expected to be limited, typical for a residential scheme of this nature. Individual apartments are to be serviced by localised ventilation/heating systems (MVHRs and the like), with the services to be located within the dwelling. Ventilation intake and exhaust will be ducted via the façade for each apartment, with in-duct attenuation to be fitted. Localised MVHRs will have negligible noise impact upon nearby NSRs.

Water storage and pumpsets are to be located within ground floor plant rooms of the proposed buildings. Internal noise transfer to adjacent dwellings within the proposed building will be controlled by the separating structures which shall meet RBC's minimum sound insulation requirements outlined in Section 2.2.4.

Some small areas of external plant are proposed at roof level at Level 6. The mechanical engineer has advised that the plant will comprise small VRF units, serving landlord/amenity areas.

Plant selections for the VRFs have not been undertaken, such equipment is variable in nature depending upon the load placed upon them, it's expected that during night-time periods, reduced loads will be placed upon the VRF equipment which serve ground floor amenity. During reduced load conditions, lower levels of noise emission are typically experienced.

Indicative equipment has been suggested by the mechanical engineer which are considered to be the most notable externally located plant:

- Mitsubishi PURY-EP700YSNW-A2 (67/65.5 dB L_{pA} @1m heating/cooling)

Smoke extract fans are anticipated to be located at rooftop level. Such fans may be used at reduced duty to provide purge/extract ventilation to core/circulation areas. At this stage, no selections have been made, however, such plant is commonly adequately treated with in duct attenuation.

Other small items of rooftop may be included to serve upper-level community amenity spaces, any such plant is likely to be minor.

Noise emission predictions have been undertaken based on the indicative VRF plant and the above noise data at 100% load. The noise emission prediction was undertaken using Cadna A, proprietary noise modelling package which performs predictions in accordance with BS EN ISO 9613¹⁰. The figures present the propagation of Specific Sound Levels (before any penalty corrections) noise across the site and upon the NSRs.

Figure 5.7: Specific Sound Level predictions at nearby Thames Quarter



The predicted Specific Sound Level is based upon the VRFs operating at 100% during the nighttime to provide heating and is considered a conservative worst-case. The resultant Specific Sound Levels are approximately 6 dB below the derived limits seen in Table 5.3.

Acoustic screening was included within the assessment around the VRF units to limit the noise levels incident upon the apartment facades that form part of the scheme in proximity to the VRF units. The screening was used to limit noise levels upon the façade here, thereby avoiding an increase in the resultant internal ambient noise levels within the apartments from the plant which would necessitate an increase in glazing performance specifications.

The predictions indicate that there is scope for further contribution from other plant items at the identified NSR, and that controlling noise levels upon the proposed development itself will likely dictate any noise control measures.

Emergency back-up generators are proposed at ground floor level within the scheme. Internal noise transfer to adjacent dwellings within the proposed building will be controlled by the separating structures which shall meet RBC's minimum sound insulation requirements outlined in Section 2.2.4.

The generators are expected to contribute to the external noise environment when in use (emergencies and periodic testing), as such their external noise emission should be controlled such that they achieve the limits outlined in Table

¹⁰ International Organisation for Standardisation (ISO) (1996); ISO 9613 'Attenuation of sound during propagation outdoors', ISO.

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5.4. Depending upon the final selections, the generators may be packaged or open, they will have external supply air intakes and external air exhausts. Adequate attenuation will be required to be fitted to generator ventilation ducts, acoustic louvres may also need to be considered where appropriate. The generator plant room envelope and any generator enclosure shall be adequately designed to mitigate noise breakout from the engine and ancillary equipment.

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Appendix A - Glossary of Acoustic Terminology

This Appendix provides a non-specialists explanation of common acoustics terms that may occur in reports and technical notes. It is intended to give a brief overview of the term.

Term	Definition
Decibel, dB	Is a unit of measurement of sound and is expressed on a logarithmic (base 10) scale. The human ear has a large dynamic range in sound reception, the logarithmic scale is a convenient way of compressing a range of sound pressures into a smaller range of numbers.
Sound Pressure Level, L_p	$L_p = 20 \log_{10} \left(\frac{P_{rms}}{P_{ref}} \right) dB$ This is the pressure deviation against a reference pressure caused by a passing sound wave. Where P_{rms} is the root mean square measured pressure and P_{ref} is the reference pressure, which is 2×10^{-5} pascals for air.
Sound Power Level, L_w	$L_w = 10 \log_{10} \left(\frac{P}{P_0} \right) dB$ This is the total sound energy radiated from a given source. P_0 is the reference sound power level (1×10^{-12}) and the measured power.
Noise Rating Level, NR dB	Commonly used when describing noise from building services systems. This is a single figure value derived by plotting a noise spectrum against a set of curves. The lowest curve under which the level fits is the resulting NR level. The overall NR value is the highest of the individual NR values for each frequency band.
Frequency, Hz	$f = \frac{1}{T} = \frac{v}{\lambda}$ Where f is the frequency, T is the time to complete one cycle, v is the speed of sound and λ is the wavelength of a given sound pressure wave. Different frequencies are divided into octave and one third octave bands.
Frequency Weightings	Weightings are often applied to a spectrum of sound and act as a filter to account for different sensitivities and conditions. Weightings are often used to present a single figure value from a spectrum of sound.
A-weighted sound pressure level, L_{pA}	The sound pressure level with the A-weighting applied. The A-weighting is used for most environmental noise measurements and is used to weight a spectrum of sound to match the sensitivity of the human ear.
Measurement Time Weightings, Fast, Slow	Depending upon the measurement in question the time response of a sound level meter can be adjusted. For most measurements the Fast time weighting is selected (F) however, a slow time weighting (S) is often used to for the measurement train noise and vibration.

Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$	An energy average and defined as the level of sound which, through a given period of time (T) would equate to the same A-weighted sound energy as the actual measured fluctuating sound.
Octave Band	A frequency band where the upper frequency of the band is twice the frequency of the lower limit.
Maximum noise Level, L_{AFmax}	With the meter set with a fast time response, F, this is the maximum instantaneous noise level measured during a given period of time.
Percentile level, $L_{AN,T}(L_{A90,T}, L_{A10,T})$	A sound pressure level which is exceeded for a given N% of a specified time period with an A-weighting and measured with a fast time response.
Background Sound/Noise Level, L_{A90}	Typically, these are amongst the lowest noise levels referenced over a given period and act to describe the noise level that is consistently exceeded 90% of the time. The background sound level excludes short term, intermittent noise sources and often acts to describe noise sources that operate consistently through a given period.
Ambient Noise Level	The most commonly used value to describe the ambient noise level the L_{Aeq} . It is the noise level in a given environment whilst it is subject to all of its normal sources of noise.
Rating Level, L_{Ar,T_r}	As defined in BS 4142. The equivalent continuous A-weighted sound pressure level that includes corrections for the presence of any acoustic characteristics such as tonality, impulsivity and intermittency.
Reverberation Time, T	The time needed for the sound pressure level to decrease by 60 dB after the sound source has stopped, often written RT60. T is often followed by descriptors to present type of reverberation time value. For example, a T_{mf} is the mid-frequency (500 Hz – 2 kHz) reverberation time.
Absorption Coefficient, α	The fraction of reverberant sound energy absorbed by a material. It is expressed as a value between 1.0 which equates to perfect absorption and 0 which equates to zero absorption.
Acoustic Absorption, A	$A = \alpha S$ This is a measure of how much sound energy is absorbed by a material rather than reflected. Acoustic absorption is derived from the multiplication of the absorption coefficient by the surface area, S m² of a given material.
Absorption Class, A - E	The process of classifying materials into discreet Classes A-E, with Class A having the highest level of absorption. Each class band has upper and lower reference curve for absorption coefficients between 200 Hz and 5 kHz. Materials should be tested in accordance with BS EN ISO 354 and classified according to BS EN ISO 11654.
NRC	A single-number value ranging from 0 (no absorption) – 1 (100% absorption) describing the absorption performance of a material. NRC of a material is calculated by averaging its Sound Absorption Coefficients between 250 Hz – 2 kHz .

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Sound Insulation	The capacity of building elements to reduce sound transmission between spaces across a range of frequencies.
Sound Reduction Index, R	$R = L_1 - L_2 + 10 \log_{10} \left(\frac{S}{A} \right) dB$ A laboratory measure of the sound insulation performance of a material in a given frequency band or range. Where L_1 is the average sound pressure level in the source room and L_2 is the average sound pressure level in the receive room, S is the area of the tested element and A is the equivalent sound absorption area.
Weighted Sound Reduction Index, R_w	A single figure value derived from a range of frequencies that characterises the sound reduction of a material. A reference curve is compared to the measured sound reduction indices and is adjusted until the total of unfavourable deviations below the reference curve is as close to but does not exceed 32.
Weighted Level Difference, D_w	$D = L_1 - L_2$ The difference in noise level between a source room and a receive room. Where L_1 is the average sound pressure level in the source room and L_2 is the average sound pressure level in the receive room. The difference is then weighted and stated as a single figure.
Standardized Weighted Level Difference, $D_{nT,w}$	$D_{nT} = D + 10 \log_{10} \left(\frac{T}{T_0} \right) dB$ Where D is the measured level difference standardised for the reference reverberation time, T_0 and then weighted.
Weighted, Normalised Flanking Level Difference, D_{nFw}	The level difference via a flanking element, such as a mullion or ceiling detail, which is normalised and weighted.
Weighted, Normalised Element Level Difference, D_{new}	The level difference through a small element such as a trickle ventilator, which is normalised and weighted.
C_{tr}	A spectrum adaption term applied to the sound insulation single-number values (R_w , D_w , and $D_{nT,w}$). The C_{tr} adaption term acts to describe the performance of an element in the context of low frequency noise, such as that generated by traffic.
Impact Sound	Is the noise generated by an impact on a structure, such as walking or weight drops.
Weighted standardized impact sound pressure level, $L_{nT,w}$	$L_{nT} = L_i - 10 \log_{10} \left(\frac{T}{T_0} \right) dB$ Where L_i is the measured impact sound pressure level standardised for the reference reverberation time, T_0. It is used to describe the impact sound insulation performance of a floor. This is a measured noise level in a receive room generated by a standardised impact source in the room above.
Insertion Loss, IL	The reduction of noise level due to the presence of a noise control device such as an attenuator, excluding any regeneration noise created by its presence. A dynamic insertion loss, DIL , would include the impact of any regenerated noise.

Cross-talk	This references noise transmission via ventilation duct or similar air path between rooms.
Vibration	The vibratory motion of a surface can be described by the displacement (m) , velocity (m/s) or the acceleration (m/s²) of its oscillation. Depending upon the circumstance it is often useful to quantify the magnitude of vibration in a range of ways, including Peak to Peak , Peak , r.m.s. and dB . A reference level of 10-6 m/s ² r.m.s. is usually used for acceleration.
Ground borne noise	Where the noise propagation path from a source is transmitted through the ground into a structure and is radiated via the structure, such as noise experienced from an underground train within a building above ground.
Structure borne noise	Noise caused by vibrating of elements of a structure, the source of which is within a building or structure with common elements.
Vibration Dose Value, VDV	$VDV = \left(\int_0^T a^4(t) dt \right)^{\frac{1}{4}}$ Where $a(t)$ is the frequency weighted acceleration (m/s²), T is the total measurement period in seconds, VDV is the Vibration Dose Value (m/s^{1.75}) and is the dose a person is expected to be exposed to over the course of the day or night.
Estimated Vibration Dose Value, $eVDV$	$eVDV = k \cdot a_{rms} \cdot t^{0.25}$ Where k is a constant for crest factors (typically 1.41), a_{rms} is the weighted rms acceleration and t is the cumulative time of the period Typically used on short duration measurements of transients with known durations and occurrences

Appendix B – Summary of Relevant Planning Policy and Guidance

National Planning Policy Framework, 2023

The National Planning Policy Framework sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally-prepared plans for housing and other developments can be produced.

One of the stated aims of the NPPF is to conserve and enhance the natural environment, as part of this new and existing developments should be prevented from contributing to or being put at risk from, or being adversely affected by unacceptable levels of noise pollution. Planning policies and decisions should aim to mitigate and reduce to a minimum potential adverse impacts resulting from noise or as a result of noise from a new development.

The NPPF makes reference to the Noise Policy Statement for England.

Noise Policy Statement for England, 2010

The aim of the NPSE is to provide clarity regarding current policies and practices to enable noise management decisions to be made within the wider context, at the most appropriate level, in a cost-effective manner and in a timely fashion.

The following are the general national noise policy aims:

- 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.

In order to define and quantify noise impacts the NPSE presents the following measures:

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.

SOAEL – Significant Observed Adverse Effect Level

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

It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.

Planning Practice Guidance, Noise 2019

The Planning Practice Guidance provides an online resource appraising when noise is relevant to the planning process, it's relationship with other planning concerns and how noise impacts can be determined. The resource references the NPSE and its approach for determining whether significant adverse effects are likely to occur.

The document presents a noise exposure hierarchy which is a useful framework for assessing the likely responses elicited by noise and whether action should be taken to mitigate.

The guidance document seeks to explain the subjective nature of noise and the factors that apply when determining the level of impact experienced.

The document also outlines how planning and design can address the adverse effects of noise.

British Standard 4142 2014 – Methods for rating and assessing industrial and commercial sound

BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature, which includes:

- a) sound from industrial and manufacturing processes;
- b) sound from fixed installations which comprise mechanical and electrical plant and equipment;
- c) sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and
- d) sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

BS 4142 is applicable to the determination of the following levels at outdoor locations:

- a) rating levels for sources of sound of an industrial and/or commercial nature; and
- b) ambient, background and residual sound levels, for the purposes of:
 - 1) investigating complaints;
 - 2) assessing sound from proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and
 - 3) assessing sound at proposed new dwellings or premises used for residential purposes.

BS 4142 defines the following terms:

Rating Level, $L_{Ar,Tr}$

Is the specific sound level plus any adjustment for the characteristic features of the sound. Characteristic features include tonality (up to +6 dB correction), impulsivity (up to + 9 dB correction) and intermittency (up to + 3 dB correction). For corrections of + 3 dB can be applied should any other characteristics be present that are distinctive against the residual acoustic environment.

Residual Sound, L_r

Is the ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.

Specific Sound Level, $L_s = L_{Aeq,Tr}$

Is the equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r .

BS 4142 presents a range of methods and examples on how ratings and assessments can be carried out.



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