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10.1 INTRODUCTION

10.1.1 This chapter has been prepared by Elena de Juan Romero at Hydrock to provide an assessment of the environmental noise impact of the proposed development and the impact of existing and future environmental noise levels on the sensitive uses (250 dwellings) within the proposed development. Elena de Juan Romero is a Senior Acoustic Engineer with Hydrock and a Member of the Institute of Acoustics. She holds an MSc in Audio Acoustics from the University of Salford and had 8 years of experience in acoustic consultancy during which she has worked on projects across a variety of sectors including: residential, education, healthcare, aviation, and commercial.A Planning Noise Assessment report (ref. 15114-HYD-ZZ-XX-RP-Y-1001) has also been provided to summarise the sections of this chapter which relate to the impact of environmental noise on sensitive receptors within the proposed development (PD). This can be found in Appendix 10.1. The development comprises residential development of up to 250 dwellings including affordable housing and ancillary uses including retained Local Wildlife Site, public open space, play areas, localised land remodelling, compensatory flood storage, structural planting and access.The proposed development will include noise and vibration sensitive uses. The impact on these from the following sources has been considered:

- Railway movements to the North and East;
- Gavray Drive to the South;
- A4421 to the West.

10.1.2 The following noise and vibration impacts on the surrounding area are also considered:Noise and vibration during the construction phase;

- Noise from fixed plant installations associated with the development;
- Increased traffic noise on local roads impacting existing receptors.

10.1.3 There are no significant vibration sources associated with operation of the PD. Therefore, vibration is considered during the construction phase only.

10.2 RELEVANT POLICY

Noise policy Statement for England (NPSE)

10.2.2 The NPSE is intended to apply to environmental noise and neighbourhood noise of all forms but excluding noise occurring in the workplace.
The NPSE cites concepts from toxicology and advises that impacts should be considered with regards to health effects and quality of life:

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

NOEL – No Observed Effect Level

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

LOAEL – Lowest Observed Adverse Effect Level

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

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

SOAEL – Significant Observed Adverse Effect Level

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

10.2.3 The NPSE does not provide any numerical thresholds for determining the magnitude of a noise impact. Moreover, the document advises that it is not possible to have *"a single objective noise-based measure…that is applicable to all sources of noise in all situations".* It further advises that the sound level at which an adverse effect occurs is *"likely to be different for different noise sources, for different receptors and at different times."*

National Planning Policy Framework (NPPF)

10.2.4 The National Planning Policy Framework1 (NPPF) is a key part of the Government's reforms to make the planning system less complex and more accessible, to protect the environment and to promote sustainable growth.

10.2.5 The NPPF constitutes guidance for local planning authorities and decision makers when drawing up plans and is a material consideration in determining applications.

10.2.6 Its core principle is to advocate a presumption in favour of sustainable development, which, in literal terms, means that if the adverse impacts of a development are outweighed by the

benefits, when assessed as a whole, then the development should be approved. Local policy should reflect this principle and therefore the Local Authority has a key role in determining within its Local Plan and noise policies, what is acceptable in terms of any adverse noise effects within its area.

10.2.7 In reference to noise, the NPPF states (Section 123): Planning policies and decisions should aim to:

- avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- mitigate and reduce to a minimum other adverse impact on health and quality of life arising from noise from new development, including through the use of conditions;
- recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established.
- identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason

Planning Practice Guidance

10.2.8 Planning Practice Guidance for Noise (PPG - Noise) is published online (https://www.gov.uk/guidance/noise--2). The guidance draws on the principles of the Noise Policy Statement for England (NPSE) and in particular the concepts of NOEL, LOAEL and SOAEL as described below:

- Significant observed adverse effect level (SOAEL): This is the level of noise exposure above which significant adverse effects on health and quality of life occur.
- Lowest observed adverse effect level (LOAEL): this is the level of noise exposure above which adverse effects on health and quality of life can be detected.
- No observed effect level (NOEL): this is the level of noise exposure below which no effect at all on health or quality of life can be detected.

10.2.9 The noise exposure hierarchy proposed by PPG - Noise is summarised in Table 10.1.

Table 10.1 Noise exposure hierarchy from PPG-N

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

10.2.10 PPG-Noise does not provide numerical values for the different effect levels, instead recognising that "The subjective nature of noise means that there is not a simple relationship

between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation". These factors include:

- The source and absolute level of the noise together with the time of day it occurs. Some types and levels of noise will cause a greater adverse effect at night than if they occurred during the day – this is because people tend to be more sensitive to noise at night as they are trying to sleep. The adverse effect can also be greater simply because there is less background noise at night.
- For non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise.
- The spectral content of the noise (ie whether or not the noise contains particular high or low frequency content) and the general character of the noise (ie whether or not the noise contains particular tonal characteristics or other particular features). The local topology and topography should also be taken into account along with the existing and, where appropriate, the planned character of the area.
- Consideration should also be given to whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time. In both cases a suitable alternative means of ventilation is likely to be necessary.

10.2.11 EIA and Government noise policy are interlinked but separate processes. In this regard a 'likely significant effect' would be reported in an EIA where a SOAEL is exceeded. However, depending on the context, an EIA may also report a likely significant effect where the exposure is between the LOAEL and SOAEL in terms of policy. This could be in response to matters such as the magnitude of noise change caused by the development, the number of receptors affected, the duration of the effect etc. The term 'significant' has different meanings in Policy and EIA terms.

10.2.12 It therefore remains for professional practitioners to carefully consider the PPG noise exposure hierarchy and where appropriate seek to align it with EIA significance criteria, having regard to British Standards, World Health Organization guidance, and other relevant sources of information.

Cherwell District Local Plan (1996)

10.2.13 The Cherwell District Local Plan was adopted in November 1996. Review of this document indicated that the following policies are in relation to noise and vibration:

- ENV1 "*Development which is likely to cause materially detrimental levels of noise, vibration, smell, smoke, fumes or other type of environmental pollution will not normally be permitted*." And
- ENV 3 "Development sensitive to noise generated by road traffic will be:
    - Refused where external noise levels exceed L*Aeq,16hr=72dB and LAeq,8hr=66dB between 07:00-23:00 hrs and 23:00-7:00 hrs respectively.*
    - *Generally resisted where external noise levels between 07:00-23:00 hrs and 23:00-07:00 hrs fall into the ranges LAeq16hr=63 to 72dB and LAeq,8hr=57 to 66dB respectively.*
    - *Expected to achieve a specified internal acoustic environment when the external noise levels between 07:00-23:00 hrs and 23:00-07:00 hrs fall into the ranges LAeq.16hr=55 to 63dB and LAeq,8hr=45 to 57dB respectively*."
- ENV 4 "*Development sensitive to noise generated by rail traffic will be:*
    - *Refused where external noise levels exceed LAeq.16hr=74dB between 07:00 - 23:00 hrs and LAeq,8hr = 66dB between 23:00 and 07:00 hrs.*
    - *Generally resisted where external noise levels between 07:00 - 23:00 and 23:00 - 07:00 fall into the ranges LAeq.16hr=66 to 74dB and LAeq,8hr=59 to 66dB respectively.*
    - *Expected to achieve a specified internal acoustic environment when external noise levels between 07:00 - 23:00 and 23:00 - 07:00 hrs fall into the ranges LAeq.16hr = 55 to 66dB and LAeq,8hr=45 to 59dB respectively."*
- ENV5 **"***Notwithstanding policies ENV3 and ENV4, development sensitive to vibration will be resisted in locations where vibration levels are likely to affect the material comfort of end users***"**

Cherwell Local Plan 2011-2031 (Adopted July 2015)

10.2.14 The Adopted Cherwell Local Plan 2011-2031 contains strategic planning policies for development and the use of land. It forms part of the statutory Development Plan for Cherwell to which regard must be given in the determination of planning applications.

10.2.15 The Plan was formally adopted by the Council on 20 July 2015. Policy Bicester 13 was re-adopted on 19 December 2016

10.2.16 Key policies identified above have been readopted or adapted for the current local plan.

The Control of Pollution Act 1974

10.2.17 The Control of Pollution Act provides Local Authorities with the power to control noise from construction sites. This may include specific controls to restrict certain activities identified as causing particular problems. Also, conditions regarding hours of operation will generally be specified and noise and vibration limits at certain locations may be applied in some cases.

10.2.18 The powers include prosecution for failure to comply with the requirements of a notice served under the act, and a system of providing prior consents for works to be carried out in a specified manner so as to reduce the likelihood of causing disturbance ('s.61 consents'). Noise generators can use the defence that best practicable means have been employed to control noise emissions.

Environmental Protection Act 1995

10.2.19 The Environmental Protection Act provides local authorities and individuals with powers to serve, or request a magistrate to serve, abatement notices against noise (including vibration) from premises that are considered to be a nuisance. Noise generators can use the defence that best practicable means have been used to control noise emissions or (in relation to construction noise) that the alleged nuisance arose from activities that were compliant with an extant consent under s.61 of the Control of Pollution Act (prior consent).

National Best Practice Guidance

British Standard BS5228

10.2.20 BS5228 Part 1: 2009+A1:2014 provides practical guidance on the control of noise from construction sites. The legislative background to noise control is described and recommendations are given regarding procedures for creating effective liaison between developers, site operators and local authorities. Methods for predicting and measuring noise are presented and guidance is given concerning the measurement of noise. Annex E of BS5228 introduces the 'ABC' assessment method, which defines the threshold of likely significant effects at receivers.

10.2.21 BS5228 Part 2: 2009+A1: 2014 provides practical guidance on the control of vibration from construction sites. The legislative background to vibration control is described and thresholds for avoiding significant impacts such as building damage are provided.

10.2.22 Both parts of BS5228 (Noise and Vibration) provide methods for prediction and case history measurements for use in predicting the noise and vibration impacts from construction sites.

10.2.23 Ground-borne vibration from construction sites can cause discomfort to occupiers of neighbouring buildings and, at much higher level, cosmetic and even structural damage.

10.2.24 Vibration may in some circumstances be perceptible at approximately 0.14 mms-1, particularly at higher frequencies. Guidance on the human response from vibration is

principally contained within BS 6472-1:2008. However, for construction induced vibration, BS 5228-2:2009 references this standard and provides the following guidance on the effects of vibration on building occupants:

Table 10.2 BS 5228-2:2009 Guidance on effects of vibration levels perceptible to humans

Vibration Level A), B), C)	Effect
0.14 mms-1	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mms-1	Vibration might be just perceptible in residential environments.
1.0 mms-1	It is likely that vibration of this level in residential environmental will cause complaint, but can be tolerated if prior warning and explanation has been given to residents
10 mms-1	Vibration is likely to be intolerable for more than very brief exposure to this level in most building environments

A) The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into the recipient.

B) A transfer function (which relates an external level to an internal level) needs to be applied if only external measurements are available.

C) Single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. The values are provided to give an initial indication of potential effects, and where these values are routinely measured or expected then an assessment in accordance with BS 6472-1 or -2, and/or other available guidance, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment.

10.2.25 At levels above the threshold for human perception, vibration can cause damage to existing structures. According to BS 7385-2, for residential or light commercial buildings, the threshold for the onset of potential cosmetic damage (i.e. formation of hairline cracks on drywall surfaces or the growth of existing cracks in plaster or drywall surfaces) to buildings varies with frequency. This ranges from a Peak Particle Velocity (PPV) (component) of 15 mms-1 at 4 Hz, rising to 20 mms-1 at 15 Hz, and to 50 mms-1 at and above 40 Hz. BS 7385-2 also states that the probability of building damage tends towards zero at 12.5 mms-1 peak component particle velocity.

10.2.26 The same thresholds are referenced in BS5228-2:2009 and are presented in Table 10.3.

Table 10.3 Transient Vibration Guide Values for Cosmetic Damage

Type of Building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures	50 mms-1 at 4 Hz and above	
Industrial and heavy commercial buildings	15 mms-1 at 4 Hz increasing to 20 mms-1 at 15 Hz	20 mms-1 at 15 Hz increasing to 50 mms-1 at 40 Hz
NOTE 1 Values referred to are at the base of the building. **NOTE 2 For unreinforced or light framed structures, at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.**		

British Standard BS 8233:2014

10.2.27 BS 8233 provides guidance for the control of noise in and around buildings. The guidance provided within the document is applicable to the design of new buildings, or refurbished buildings undergoing a change of use, but does not provide guidance on assessing the effects of changes in the external noise levels to occupants of an existing building. The guidance provided includes appropriate internal and external noise level criteria which are applicable to dwellings and other types of building.

Table 10.4 Internal Noise Limits for Dwellings from BS8233:2014

Activity	Location	Period	
		Daytime (07:00 to 23:00 hrs)	Night-time (23:00 to 07:00 hrs)
Resting	Living room	$L_{Aeq,16hrs}$ 35 dB	-
Dining	Dining room/area	$L_{Aeq,16hrs}$ 40 dB	-
Sleeping (daytime resting)	Bedroom	$L_{Aeq,16hrs}$ 35 dB	$L_{Aeq,8hrs}$ 30 dB

10.2.28 Whilst BS 8233:2014 recognises that a guideline value may be set in terms of SEL or L_{AFmax} in bedrooms of dwellings during the night-time to minimise the risk from regular individual noise events that can affect sleep quality, a specific criterion is not stipulated. Therefore,

guidance on maximum night-time noise levels from World Health Organisation (WHO) 1999: Guidelines for Community Noise are often used in the UK, including within ProPG.

10.2.29 From WHO: *"When the background noise is low, noise exceeding 45 dB L_{Amax} should be limited, if possible, and for sensitive persons an even lower limit is preferred. Noise mitigation targeted to the first part of the night is believed to be an effective means for helping people fall asleep. It should be noted that the adverse effect of noise partly depends on the nature of the source."*

10.2.30 For noise in external amenity areas (gardens and balconies) BS8233:2014 gives an upper guideline level of 55 dB L_{Aeq} but states that 50 dB L_{Aeq} is desirable. However, with reference to the National Noise Incidence Survey carried out in 2000 / 2001 (BRE), 54% of the UK population are exposed to daytime noise levels at or above 55 dB $L_{Aeq\ 16hr}$. Therefore, it will not be possible to achieve the upper guideline noise level at many suitable residential sites and it is often necessary to compromise. This is acknowledged in BS8233:2014, as follows:

"…it is also recognised 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 convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted."

British Standard 4142:2014+A1:2019

10.2.31 The standard method for assessing noise from commercial and industrial premises in the UK is British Standard BS 4142 "Method for rating and assessing industrial and commercial sound". The standard is applicable for assessing noise affecting "dwellings or premises used for residential purposes" and can be used to assess the impact of new commercial or industrial types of noise (including mechanical plant) on existing dwellings or existing noise generating uses on proposed dwellings.

10.2.32 A BS 4142 assessment is made by determining the difference between the specific noise under consideration and the background sound level, as represented by the LA90 parameter, determined in the absence of the commercial sound. The LA90 parameter is defined as the level exceeded for 90% of the measurement time. This parameter therefore excludes short duration noise events, such as individual vehicle movements, and represents the underlying continuous noise.

10.2.33 The commercial or industrial sound is assessed in terms of the equivalent continuous noise level, LAeq. The equivalent continuous noise level (L_{Aeq}) of the commercial or industrial sound, over the applicable assessment period, is known as the specific sound level.

10.2.34 A character correction penalty can be applied to the specific sound level where the commercial noise exhibits distinguishable tones, impulsiveness, intermittency or other characteristics which "are otherwise readily distinctive against the residual acoustic environment".

10.2.35 The specific noise level with the character correction (if necessary) is known as rating level (L_{Ar}) and the difference between the background noise and the rating level is determined to make the BS 4142 assessment. The following is then considered.

"a) Typically, the greater this difference, the greater the magnitude of the impact.

b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."

10.2.36 The standard highlights the importance of considering the context in which a sound occurs. Factors including the absolute sound level, the character of the sound, the sensitivity of the receptor and the existing acoustic character of the area should be considered when assessing the noise impact. The use of the proposed premises for residential use is also pertinent to the consideration of context.

10.2.37 The standard notes the need to consider absolute sound levels where background sound levels are low:

"For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

Where the background sound levels and rating level are low, absolute levels might be as, or more, relevant than margin by which the rating level exceeds the background. This is especially true at night."

World Health Organisation (WHO) Guidelines on Community Noise

10.2.38 The WHO "Guidelines on Community Noise", Berglund et. al., 1999 provides guidance on all types of noise excluding noise in the work place. This includes noise from: transport infrastructure, industrial and commercial activity, and other forms of neighbourhood noise. The document discusses the impacts of noise with reference to health effects, annoyance, sleep disturbance, performance, interference with speech communication and other activity specific impacts.

10.2.39 Recommended equivalent continuous (average) internal noise levels for habitable rooms are generally in line with those from BS8233:2014 but the document also recommends a limit for individual short term noise events:

"When noise is continuous, the equivalent sound pressure level should not exceed 30 dB(A) indoors, if negative effects on sleep are to be avoided. For noise with a large proportion of low-frequency sound a still lower guideline value is recommended. When the background noise is low, noise exceeding 45 dB L_{Amax} should be limited, if possible, and for sensitive persons an even lower limit is preferred. Noise mitigation targeted to the first part of the night is believed to be an effective means for helping people fall asleep. It should be noted that the adverse effect of noise partly depends on the nature of the source."

10.2.40 The short-term maximum noise limit for good sleep appears to be based on research from Vallet & Vernet which is quoted by the WHO Guidelines as follows:

"For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10–15 times per night (Vallet & Vernet 1991)"

10.2.41 Therefore, the 45 dB L_{Amax} criterion is not intended to be an absolute limit, i.e., a limited number of exceedances is acceptable and these may be less significant in the middle of the night or early morning.

10.2.42 The WHO Guidelines also suggests external noise limits for mitigating annoyance:

"The capacity of a noise to induce annoyance depends upon its physical characteristics, including the sound pressure level, spectral characteristics and variations of these properties with time. During daytime, few people are highly annoyed at L_{Aeq} levels below 55 dB(A), and few are moderately annoyed at L_{Aeq} levels below 50 dB(A). Sound levels during the evening and night should be 5–10 dB lower than during the day. Noise with low-frequency components require lower guideline values. For intermittent noise, it is emphasized that it is necessary to take into account both the maximum sound pressure level and the number of noise events. Guidelines or noise abatement measures should also take into account residential outdoor activities."

10.2.43 Note, the WHO external noise thresholds for moderate annoyance are approximately equal to the recommended internal noise levels for habitable rooms based on the standard assumption (used within the WHO Guidelines) of 15 dB attenuation through an open window.

10.2.44 In the UK, the annoyance thresholds from the WHO Guidelines are often assumed to only relate to transports or "anonymous" noise sources. That is, ambient noise for which no individual person or commercial operation can be held responsible. This is not always how the WHO Guidelines are interpreted, for example the World Bank imposes a 45 dB L_{Aeq} external noise limit on new power stations for which it provides funding which is likely based on the WHO Guidelines.

10.2.45 The UK common interpretation may be because internal noise limits equivalent to the WHO annoyance thresholds were previously said to relate to *"anonymous"* noise in pre 2014 editions of BS8233 or due to the generally lower noise limits which would result from a BS4142 assessment of industrial or commercial noise. It should be noted that the current edition of BS8233 omits the word *"anonymous"* and instead qualifies the internal noise limits as relating to "noise without a specific character".

10.2.46 However, the WHO Guidelines do point out that various non-acoustic factors can impact the level of annoyance resulting from a given source, which is in line with the 2014 update to BS4142:

"Annoyance in populations exposed to environmental noise varies not only with the acoustical characteristics of the noise (source, exposure), but also with many non-acoustical factors of social, psychological, or economic nature (Fields 1993). These factors include fear associated with the noise source, conviction that the noise could be reduced by third parties, individual noise sensitivity, the degree to which an individual feels able to control the noise (coping strategies), and whether the noise originates from an important economic activity."

ProPG: Planning & Noise

10.2.47 Professional Practice Guidance on Planning and Noise, IoA, ANC, CIEH (May 2017) provides guidance on transportation noise affecting new residential developments. It is specifically for assessing noise from predominantly transportation sources.

10.2.48 The guidance promotes a two-stage assessment approach:

- Stage 1 – Initial site noise risk assessment based on external noise levels;
- Stage 2 – Full assessment including assessment of internal noise levels.

10.2.49 Where the Stage 1 assessment indicates a negligible noise risk a Stage 2 assessment is not required. A negligible noise risk approximately correlates to external noise levels below 50dB $L_{Aeq, 16hr}$ (daytime) and 40 dB $L_{Aeq, 8hr}$ (night).

10.2.50 In terms of internal noise limits ProPG says "It is considered that suitable guidance on internal noise levels can be found in BS8233:2014: Guidance on sound insulation and noise reduction for buildings" and appends the BS8233:2014 noise limits by mirroring the WHO Guidelines, as follows:

"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 $L_{Amax,F}$ 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"

Acoustics Ventilation and Overheating – Residential Design Guide (AVO Guide)

10.2.51 A document published by the Institute of Acoustics (IOA) and Association of Noise Consultants (ANC) that recommends an approach to the assessment of environmental noise impact on new dwellings that takes due regard to the interdependence of provisions for acoustics, ventilation, and overheating.

10.2.52 The document provides a means by which designers can consider the effects of noise when windows are open to cool an overheating room and the impact of having to keep windows closed due to excessive external noise in line with PPG – Noise, i.e:

"Consideration should also be given to whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time."

Design Manual for Roads and Bridges, Volume 11, Section 7

10.2.53 An approach to assessing noise and vibration effects from roads is described in Design Manual for Roads and Bridges (DMRB) relating to environmental assessment. The DMRB approach to assessing noise and vibration impact is to compare the noise levels for the 'do something' (with scheme) scenario against levels that would occur if the proposed development did not take place, i.e 'do minimum' (without scheme) scenario.

10.2.54 The assessment methodology considers the change in noise levels due to the scheme in the short and long term. DMRB is intended for use in the assessment of new or altered highways.

However, it provides a useful reference for considering the impact of traffic increases due to other types of development.

Calculation of Road Traffic Noise

10.2.55 The road traffic noise generated by new or altered roads associated with a proposed development can be calculated using the Calculation of Road Traffic Noise (CRTN) methodology. The noise levels generated by the road are based on the volume, average speed, road surface type and composition of the traffic. The resulting noise levels at selected receiver locations can then be calculated taking into account the propagation distance, intervening screening and other effects.

10.3 ASSESSMENT METHODOLOGY

Scope

Hydrock Scoping Opinion

10.3.1 An EIA Scoping Report was submitted to Cherwell District Council in September 2020.

10.3.2 A summary of the noise and vibration assessment methodology outlined within the scoping report is as follows:

- Assessment of potential noise and vibration effects associated with the construction phase of the development, undertaken in accordance with BS 5228-1:2009+A1:2014 and BS 5228-2:2009+A1:2014;
- Assessment of potential noise effects associated with development-generated road traffic, in accordance CRTN (calculation of Road Traffic Noise) and the DRMB (Design Manual Roads and Bridges);
- Assessment of potential effects associated with proposed ancillary equipment associated with the proposed Development will be set in accordance with BS4142:2014 + A1:2019.
- Assessment of potential noise effects at proposed sensitive areas within the Proposed Development during the operational Phase of the Development (future scenario) as a result of external industrial and commercial noise source in accordance with BS4142:2014 + A1: 2019.
- Assessment of potential noise effects at proposed sensitive areas within the Proposed Development during the operational Phase of the Development (future scenario) as a result of rail traffic in the vicinity assessed in accordance with CRN (Calculation of railway noise).

10.3.3 The formal Scoping Opinion was issued by Cherwell District Council on 11th November 2020, and it has been accepted that an EIA is required.

10.3.4 The Scoping Opinion states:

"Noise in particular has the potential to have a serious adverse impact on the development. The Council's Environmental Health officer has highlighted the existing noise impact from the railway lines and link which border the site. The upgrade of the line to Milton Keynes and beyond as part of the East West Rail project will only increase the number of trains passing the site. The line to the Chiltern Mainline is also raised above the site increasing the potential for noise disturbance and the industrial units across the railway line are also sources of noise

which will need to be assessed. In the interest of securing a robust EIA, the LPA considers that noise and air quality should be scoped in."

Methodology Feedback from Cherwell District Council

10.3.5 Hydrock provided a noise survey and assessment methodology overview email to Cherwell District Council in December 2020, via email.

10.3.6 The email set out a review of current guidance to be used for this assessment. Given the majority of 2020 has been subject to Covid-19 restrictions, or associated effects on transportation, survey data collected in 2020 in tandem with additional modelling assessments as described is considered robust approach.

10.3.7 This approach is in accordance with IOA (Institute of Acoustics) and ANC (Association of Nosie Consultants) present guidance on COVID-19.

10.3.8 Formal response was received from Neil Whitton EHO at Cherwell District Council.

10.3.9 In general terms the site survey methodology and proposal for additional validation desktop noise modelling was accepted.

10.3.10 The EHO highlighted the additional considerations to be incorporate into the noise and vibration chapter.

"The East West Rail project that will increase the number of freight and passenger trains passing the site is currently under construction.

The noise from the industrial sources across the railway on the northern edge is a 24-hour operation for at least one business."

10.3.11 On the basis of the above consideration will be given to industrial operations adjacent over a 24-hour period, in addition additional rail traffic modelling will be undertaken with a view to accommodating future traffic increases in the design mitigation for residences.

10.3.12 Consideration has also been given to the potential impact of Covid-19 on existing road and rail noise sources, thus where required timetables has been consulted to compensate for cancelled rail movements, and projected future road and rail expansion has also been considered.

10.3.13 For road traffic, given the influence of Covid-19 it is appropriate to use pre-Covid 19 road traffic data to provide robust baseline information.

Assessment Approach to Construction Noise & Vibration

Construction Noise

10.3.14 The generic construction sequence of works which are considered to be the most likely to give rise to significant noise effects can be divided into four specific activities:

- Activity 1: Site enabling works. Tracked excavators, continuous movements of tipper trucks removing material and a compacting roller. (This type of activity is considered applicable to all areas of the proposed construction works).
- Activity 2: Piling. Rotary bored piling, cast in situ.
- Activity 3: Concrete pours. Foundation and basement works for buildings, including any piling activities. Concrete pouring using truck mixers and lorry mounted concrete pumps.
- Activity 4: Construction to roof level. Fabrication of steel structures, potentially some concrete pours, craning of materials and wall sections to buildings, bricklaying.

10.3.15 The likely significant effects of noise from construction and demolition works have been assessed in accordance with the 'ABC Method' of BS5228-1

10.3.16 This method defines category threshold values which are determined by the time of day and existing monitored ambient noise levels in the vicinity of existing sensitive receptors (rounded to the nearest 5dB). Noise likely to be generated by construction and demolition activities, known as the 'total noise level', is then compared with the 'threshold value'. If the total noise level exceeds the 'threshold value', a significant effect is deemed likely to occur.

10.3.17 Table 10.5 summarises the significance effect threshold values at receptors, recommended by BS5228-1.

Table 10.5 Thresholds of Significant Effect at Residential Receptors in Accordance with the ABC Method of BS5228-1

Assessment Category Threshold Value Period	Threshold Value, dB		
	Category A *1	Category B *2	Category C *3
Weekday Daytime (07:00 to 19:00) and Saturdays (07:00 to 10:00)	65	70	75
*1 Category A: Threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than this value. *2 Category B: Threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values. *3 Category C: Threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are more than this value.			

Construction Vibration

10.3.18 The sensitivity of receptors to construction vibration are listed from least sensitive to greatest sensitivity below.

- Reinforced or framed industrial and commercial buildings
- Unreinforced or light framed commercial or industrial buildings including schools
- Residential buildings
- Buildings containing vibration sensitive equipment such as high-power microscopes, MRI machines (e.g., Hospitals and Laboratories)

10.3.19 The likely magnitude of construction vibration at receptors will be assessed based on case history data from BS5228-2 and other sources. Existing receptors close to the proposed development are primarily residential properties. Based on the guidance from BS5228-1 the significance criteria for unreinforced or light framed residential buildings are presented in Table 10.6.

Table 10.6 Significance Criteria for Construction Vibration Affecting Residential Properties

Descriptor	Range	Effect
High	> 15 mms^{-1}	Potential for cosmetic building damage - should be avoided
Medium	5 - 10 mms^{-1}	Vibration at the upper end of this range is likely to be intolerable for more than very brief exposure - Can be managed through close consultation with affected receptors.
Low	1 – 5 mms^{-1}	It is likely that vibration of this level in residential environmental will cause complaint, but can be tolerated if prior warning and explanation has been given to residents
Negligible	< 1 mms^{-1}	Vibration might be just perceptible in residential environments.

10.3.20 As stated in BS5228-2 and as generally accepted, the threshold of vibration perception for humans is typically in the Peak Particle Velocity (PPV) range of 0.14 mms-1 to 0.3mm/s, which forms the basis of the recommend maximum permitted vibration levels of 1 mms-1 PPV within occupied residential dwellings.

Road Traffic Noise affecting Existing Receptors

10.3.21 DMRB provides guidance on defining the magnitude of noise impacts associated with changes in road traffic flows, related to the Proposed Development.

10.3.22 The magnitude of effect can be determined on the basis of a change in road traffic noise level, in terms of $L_{Aeq, 18hour}$, as detailed in Table 10.4. However, it is considered that the absolute level of road traffic noise is also relevant in the determining of noise impacts.

Table 10.7 Short-Term and Long-Term Magnitude of Change in Road Traffic Noise, according to DMRB

Level of Magnitude	Short Term Change in Noise Level $L_{10,18hour}$ dB(A)	Long Term Change in Noise Level $L_{10,18hour}$ dB(A)	Significance of Impact – as described in DMRB
High	≥ 5.0	≥ 10.0	Major
Medium	3.0-4.9	5.0-9.9	Moderate
Low	1.0-2.9	3.0-4.9	Minor
Negligible	0.1-0.9	0.1-2.9	Negligible
	0.0	0.0	No Change

10.3.23 Table 10.9 describes the magnitude of noise and vibration impact effects. These magnitude descriptors are based upon IEMA Guidelines for Environmental Noise Impact Assessment, and the descriptions based on the Noise Exposure Hierarchy in PPG-Noise.

Table 10.8 Magnitude of impact

Descriptor	Description
High	Impact resulting in a considerable change in baseline environmental conditions predicted either to cause statutory objectives to be significantly exceeded or to result in severe undesirable/desirable consequences on the receiving environment.
Medium	Impact resulting in a discernible change in baseline environmental conditions predicted either to cause statutory objectives to be marginally exceeded or to result in undesirable/desirable consequences on the receiving environment.
Low	Impact resulting in a change in baseline environmental conditions with undesirable/desirable conditions that can be tolerated.
Negligible	No discernible change in baseline environmental conditions.

10.3.24 Table 10.10 describes the sensitivity of receptors.

Table 10.9 Sensitivity of receptor

Descriptor	Description
High	Receptor/resource has little ability to absorb change without fundamentally altering its present character, or of international or national importance. For example, hospitals, residential care homes, and internationally and nationally designated nature conservation sites which are also known to contain noise sensitive species (i.e. noise may change breeding habits or threaten species in some other way).
Medium	Receptor/resource has moderate capacity to absorb change without significantly altering its present character. For example, residential dwellings, offices, schools, and play areas. Locally designated nature conservation sites which are also known to contain noise sensitive species (i.e. noise may change breeding habits or threaten species in some other way).
Low	Receptor/resources is tolerant of change without detriment to its character or is of low or local importance. For example, industrial estates.
Negligible	Receptor/resource is not sensitive to noise.

10.3.25 The significance of effect is determined by the interaction between magnitude of impact (Table 10.8) and sensitivity of receptor (Table 10.9). Magnitude descriptors are based upon IEMA Guidelines for Environmental Noise Impact Assessment, and the descriptions based on the Noise Exposure Hierarchy in PPG-Noise.

Table 10.10 Significance of effect matrix

Magnitude of Effect	Sensitivity of Receptors			
	High	Medium	Low	Negligible
High	Substantial	Major	Moderate	Minor
Medium	Major	Major	Moderate	Neutral
Low	Moderate	Moderate	Minor	Neutral
Negligible	Minor	Neutral	Neutral	Neutral

10.3.26 In terms of significant of effect (in EIA terms), the threshold between insignificant and significant lies between 'Moderate' and 'Major' as identified within Table 10.11. Moderate impacts may be noticeable and intrusive but may cause a small change in behaviour.

Whereas Substantial impacts are likely to be noticeable and disruptive, and might cause a material change in behaviour or attitude.

Road and Rail Traffic Noise affecting Proposed Receptors

10.3.27 The impact of existing noise sources impacting the new proposed residential dwellings will be assessed based on the internal noise limits from BS8233 and the advice of ProPG & The AVO Guide.

10.3.28 The significance criteria for road and other environmental noise, excluding commercial noise, affecting new dwellings is set out in Table 10.11.

Table 10.11: Significance Criteria for Road and other Anonymous Noise affecting Dwellings

Magnitude of Impact	Daytime Noise Level, dB LAeq 16 hour (07:00 to 23:00 hours)	Night-time Noise Level, dB LAeq 16 hour (07:00 to 23:00 hours)	Description of Effect
High	> 70	> 60	Unacceptable Impact. Significant impact on sleep quality is likely when windows are open and changes in behaviour due to noise are common.
Medium	57 - 70	52 - 60	Significant Observed Adverse Effect. Sleeping with windows open may impact quality sleep and, particularly at the upper end of this level, daytime noise in external areas and inside with windows open will impact amenity.
Low	52 - 56	47 - 51	Lowest Observed Adverse Effect. Good internal conditions will be achieved with windows closed and ventilation provided by a trickle vent. When windows are open to cool an overheating room, conditions will normally still be reasonable, as defined in BS8233:2014.
Negligible	< 51	< 46	No observed adverse effect. Good internal conditions, as defined in BS8233:2014 and WHO Guidelines, can generally be achieved, even with windows open.

Plant Noise affecting Existing Receptors

10.3.29 Noise levels from proposed ancillary equipment associated with the Proposed Development, would need to be controlled to ensure that it would not have an adverse effect on Proposed Sensitive Receptors (PSRs) and Existing Sensitive Receptors (ESRs), relative to the existing background sound level. Criteria for the assessment are set in accordance with BS 4142:2014. Using the baseline noise levels recorded at, and in the vicinity of, the PD site, noise limits for ancillary equipment have been calculated to ensure the requirements are met.

10.3.30 Where possible, noise associated with the ancillary equipment at the PD Site should be controlled to the levels outlined in Table 10.12. The recommended limits correspond to noise levels which are 5dB below the existing average background sound levels.

Table 10.12 Significance criteria for noise impacting the new proposed gardens

Monitoring Location	Parameter	Time Period	Measured Background Noise Level, L_{A90}, dB
ML1	$L_{Ar,1hour}$	Daytime (0700hrs to 2300hrs)	40
	$L_{Ar,15mins}$	Night Time (2300hrs to 0700hrs)	31
ML2	$L_{Ar,1hour}$	Daytime (0700hrs to 2300hrs)	40
	$L_{Ar,15mins}$	Night Time (2300hrs to 0700hrs)	31

10.3.31 The above recommended noise limits are intended to provide conservative guideline values for this stage, in the absence of detailed information. A full assessment is likely to be required once detailed information becomes available, in accordance with BS4142:2014. A later assessment may include later or a more detailed assessment of the background sound levels.

10.3.32 The responsibility to achieve the above limits, or other limits set in accordance with BS4142:2014 and a later measured background sound level, would fall to those undertaking the building works.

10.3.33 As detailed information relating to fixed plant is unknown, Hydrock highlights that provision for the selection of low noise equipment, silencers, enclosures, screens and other acoustic attenuation measures may be required.

Uncertainties and limitations

10.3.34 Any limitations and uncertainties are recorded in the relevant section of the Report.

10.4 BASELINE CONDITIONS

The current baseline

Noise and Vibration Survey

10.4.1 A baseline noise survey was carried out over the period 22nd to 26th January 2021, covering both weekday and weekend periods. Weekday and weekend daytime periods were found to be relatively similar in level over the survey period.

10.4.2 Given the practicalities of forming properly validated judgements on noise surveys undertaken in 2021, due to the influence of variable Covid-19 lockdown impacts on rail timetables and road traffic, a baseline noise map model has been prepared to accompany noise surveying undertaken. The baseline noise model has been generated using inputs from rail timetables and road traffic count data for periods unaffected by Covid-19 restrictions.

10.4.3 Observations made during the surveys allowed any significant existing noise sources which contribute to the measured levels, to be identified. In addition, measurements undertaken at ML1 and ML2 included audio recording to allow retrospective analysis of the existing noise environment. The following noise sources were identified.

10.4.4 Road Traffic Noise: Noise from the adjacent road network was a contributing source for the majority of the daytime and night-time periods. Prevailing road noise sources include:

- Gavray Drive to the south-west
- A4421 to the east

10.4.5 Rail Noise: Noise from rail movements on the London to Portsmouth via Basingstoke rail line, was dominant during the daytime and night time periods at the North and Eastern part of the site.

10.4.6 Industrial Noise: Industrial noise was not found to be regularly audible during the daytime period and was inaudible during the night-time period.

10.4.7 Other: Bird song and other wildlife noises were occasionally audible during the daytime and night-time period. Noise from distant aircraft was occasionally audible.

10.4.8 Measured noise levels at each measurement location (ML) have been determined for daytime (0700 to 2300 hours) and night-time (2300 to 0700 hours) periods.

10.4.9 The main acoustic parameters were measured using a time interval of 5-minute periods for ML1 and 15 minutes for ML2. Table 10.13 and 10.14 present the daytime and night-time values at each measurement location, used to inform this assessment.

Table 10.13 Average Measured Daytime and Night-time Noise Levels -ML1

Start Time	End Time	L_{Aeq}, dB	L_{Amax} dB (Maximum)	L_{Amax} dB (Average)	L_{Amax}, dB exceeded 10 times	L_{A90} Mean, dB	L_{A90} Mode dB
22/01/2021 16:10:00	22/01/2021 23:00:00	55	87	62	80	42	45
22/01/2021 19:00:00	22/01/2021 23:00:00	54	87	58	73	39	45
22/01/2021 23:00:00	23/01/2021 07:00:00	46	79	49	65	35	32
23/01/2021 07:00:00	23/01/2021 23:00:00	54	89	62	79	41	43
23/01/2021 19:00:00	23/01/2021 23:00:00	54	89	61	76	39	40
23/01/2021 23:00:00	24/01/2021 07:00:00	45	78	48	53	34	33
24/01/2021 07:00:00	24/01/2021 23:00:00	52	82	59	79	36	37
24/01/2021 19:00:00	24/01/2021 23:00:00	51	80	57	65	36	37
24/01/2021 23:00:00	25/01/2021 07:00:00	47	80	48	64	36	34
25/01/2021 07:00:00	25/01/2021 23:00:00	51	85	59	78	43	45
25/01/2021 19:00:00	25/01/2021 23:00:00	50	80	56	64	40	42
25/01/2021 23:00:00	26/01/2021 07:00:00	49	80	50	64	39	37
26/01/2021 07:00:00	26/01/2021 15:10:00	54	87	63	78	48	48

Table 10.14 Average Measured Daytime and Night-time Noise Levels -ML2

Start Time	End Time	L_{Aeq}, dB	L_{Amax} (Maximum), dB	L_{Amax} (Average) dB	L_{Amax}, dB exceeded 10 times	L_{A90} Mean, dB	L_{A90} Mode dB
22/01/2021 15:45:00	22/01/2021 23:00:00	52	82	70	74	42	45
22/01/2021 19:00:00	22/01/2021 23:00:00	51	77	69	66	38	36
22/01/2021 23:00:00	23/01/2021 07:00:00	44	74	55	64	35	35
23/01/2021 07:00:00	23/01/2021 23:00:00	51	82	72	74	40	40
23/01/2021 19:00:00	23/01/2021 23:00:00	50	75	72	71	39	39
23/01/2021 23:00:00	24/01/2021 07:00:00	43	74	53	53	34	36
24/01/2021 07:00:00	24/01/2021 23:00:00	49	83	67	73	34	33
24/01/2021 19:00:00	24/01/2021 23:00:00	47	73	63	65	33	32
24/01/2021 23:00:00	25/01/2021 07:00:00	44	78	55	66	34	30
25/01/2021 07:00:00	25/01/2021 23:00:00	49	84	63	72	43	45
25/01/2021 19:00:00	25/01/2021 23:00:00	47	74	62	51	39	39
25/01/2021 23:00:00	26/01/2021 07:00:00	46	76	55	61	38	37
26/01/2021 07:00:00	26/01/2021 13:00:00	53	86	68	72	48	48

Road Traffic Modelling Data

10.4.10 Due to the influence of Covid-19 on local road traffic, it is appropriate to consult road traffic count data from 2014, expanded to 2019 "pre covid 19" levels.

Rail Traffic Modelling Data

10.4.11 Hydrock have progressed this chapter by using rail passenger and freight timetable source data from 2021 including cancellations made due to the Covid-19 travel reductions.

10.4.12 Where relevant Hydrock have also sourced information from noise survey measurements taken by Environmental Resources Management (ERM) at the site to accompany the Chiltern Railways application for the now operational Bicester Chord development works (shown on Figure 10.1). The data is found in "Scheme of Assessment for Route Section A", reference 0221083/11/04 January 2014.

10.4.13 The model outputs are used here to determine the baseline noise climate on the site. This approach is robust in that it uses recent representative survey data and data derived from rail movement data for the local rail track infrastructure to provide a baseline assessment.

10.4.14 The recognized national calculation method for airborne noise from railways which was used here is given in Calculation of Railway Noise, 1995 (CRN), with additional source terms given in "Additional railway noise source terms for Calculation of Railway Noise 1995". This approach was agreed with the Local Authority and was also used in the ERM assessment to inform the Chiltern Railways application for the Bicester Chord, which was accepted as appropriate.

10.4.15 The Scheme of Assessment for Route Section A advised on an acoustic barrier of 2.5m. However, based on Hydrock on site observations the acoustic barrier has only been installed to the extent such that it protects existing noise sensitive receptors as would be expected and for a short reach into the proposed development site western boundary before the railway line moves to an elevated position to the north of the site, and as such proposed development will still be exposed to rail noise along the chord without further mitigation being designed into the development.

The projected future baseline

10.4.16 Figure 10.1 shows the identified noise sources impacting the site.

Figure 10.1 Identified noise sources

Rail Traffic

10.4.17 In relation to the "east west" rail expansion, the prior ES Chapter 10 for noise enclosed within "The Network Rail (East West Rail Western Section Phase 2) Order EIA", for the operational phase assessed two rail service specifications, one for the opening year (2024) and one "growth" scenario for a "future" year (2035).

10.4.18 The future year scenario takes account of the maximum possible increase in rail services, given the constraints of the wider railway network. As such this represents the reasonable "worst case" in terms of frequency of rail movements via this link, giving consideration for future expansion.

10.4.19 The future year scenario takes account of the maximum possible increase in rail services, given the constraints of the wider railway network. As such this represents the reasonable "worst case" in terms of frequency of rail movements via this link, giving consideration for future expansion.

10.4.20 The project includes a combination of passenger and freight services, the operational periods for passenger and freight trains is as follows:

- Passenger services will run between 05:00 and 01:00
- Freight trains may operate to schedule 24 hours a day.

10.4.21 For passenger services the project includes varying train types, however the majority of passenger services will be DMUs, for freight trains services will likely be Class 66 and Class 70 locomotives.

Road traffic Noise impact on Surroundings

10.4.22 Available traffic counts for future baseline 2026 and 2026 with development have been used in order to find the impact on nearby roads. This is assessed in this report as an operational impact on Section 10.5.

10.5 POTENTIAL EFFECTS

Construction stage

Noise

10.5.1 The activities associated with construction have the potential to generate noise that propagates beyond the site boundary.

10.5.2 At this stage, detailed information regarding the nature and timescales of activities likely to take place during the construction phase are not known.

10.5.3 The contractor undertaking the enabling and construction works has not yet been appointed, therefore, for the purposes of this assessment it is assumed that the enabling and construction works will be restricted to daytime hours (i.e. between 08:00 and 18:00 hours Monday to Friday and 08:00 to 13:00 hours on a Saturday, with no work on Sunday and Bank Holidays).

10.5.4 The greatest noise impact is expected to be during construction of the access road and ground works and foundation construction of those houses closest to the boundary. The highest likely noise levels from plant items associated with each of these elements are presented in Table 10.15. The category of the sensitive receptor has been based on the measured ambient noise levels.

Table 10.15 Construction noise levels

Road	Threshold value	Construction noise level $L_{Aeq,T}$		
		Vibratory plate (petrol)	Tracked excavator	Concrete pump
Sensitive receptors on Gavray Drive	65 (Category A)	78	68	62

10.5.5 In the worst-case scenario, there will be a **medium** magnitude of noise impact. However, this will only occur when equipment is operating the closest to the site boundary. It is not expected that this will happen for longer than a few days during the construction phase. Therefore, the significance of impact will be **minor** in the short term.

10.5.6 It is recommended that mitigation measures be put in to place in order to avoid and/or reduce potential impacts where possible. Further, detail is provided in the Mitigation Section of this Chapter.

Vibration

10.5.7 BS 5228-2 provides some case history on measured vibration levels during piling activity but not for general construction activity. The highest levels of vibration from non-piling activity are likely from movement and operation of large plant. Measured data published by Crossrail during the operation of a range of excavators with breaker attachments has been reproduced in Table 10.16.

Table 10.16: Summary of Measured Maximum Component PPVs

Plant	Measured Distance from Source			
	3.1m	5.8m	7.6m	11.3m
	Level of vibration measured at nearest point (mms-1)			
3t Excavator + Breaker	2.86	-	-	0.14
8t Excavator + Breaker	12.54	0.96	0.48	0.39
13t Excavator + Breaker	-	2.03	0.51	-
20t Excavator + Breaker	-	7.91	2.37	-

10.5.8 It should be noted that the Table 10.18 levels are from demolition operations with a breaker. No demolition activity is expected on the proposed development site. Vibration levels during normal ground works activity, and all other non-piling construction activity, are likely to be lower.

10.5.9 Vibration levels during normal ground works activity, and all other non-piling construction activity, are likely to be lower.

10.5.10 The closest receptors to the site boundary are 10m away. Therefore, vibration levels from non-piling activity are unlikely to exceed the minimum significance threshold (1 mms^{-1}) at receptors and would not normally be perceptible (i.e. <0.3 mms^{-1}).

10.5.11 Vibration levels from driven piles at receptors will depend on the following:

- Energy per blow or cycle of piling rig;
- Distance to receptor;
- Ground conditions,
- Receptor building foundation type.

10.5.12 Variations in the above result in large differences in vibration levels from site to site.

Operational Impacts

Road Noise Increases on Local Roads

10.5.13 Noise modelling has been carried out in accordance with Calculation of Road Traffic Noise (CRTN), 1988, to assess the impact of road traffic noise increases due to the proposed development.

10.5.14 Affected routes are Gavray Drive and the A4421. Predicted changes in road noise levels at receptors along these routes are presented in Table 10.19.

10.5.15 The assessment of the effects has been carried out considering the difference between the Do Something (DS) and Do Minimum (DM) scenarios.

Table 10.17 Summary of Predicted Road Traffic Noise Levels for Assessment Scenarios

Road	Predicted $L_{10, 18hour}$ noise level				
	Scenario 1: 2019 Baseline	**Scenario 2: 2026 Baseline (without scheme)**	**Scenario 3: 2026 with scheme**	**Predicted Change: Scenario 1 to Scenario 3**	**Predicted Change: Scenario 2 to Scenario 3**
Gavray Drive west of A4421	60.1	59.8	61.7	1.6	**1.9**
A4421 north of Gavray Drive	73.0	75.2	75.4	2.4	**0.2**
A4421 south of Gavray Drive	72.9	72.4	72.5	-0.4	**0.1**
A4421 south of Peregrin Way (N)	72.4	71.5	71.6	-0.8	**0.1**
A4421 south of Peregrin Way (S)	72.4	72.6	72.7	0.3	**0.1**

10.5.16 The predicted changes in noise levels associated with the development-generated road traffic have been assessed in accordance with the DMRB magnitude criteria set out in Table 10.5, together with sensitivity criteria set out in Table 10.6. Existing residential dwellings are considered to be of medium sensitivity as described.

10.5.17 When assessing the change in noise levels due to the scheme i.e. comparing '2026 Baseline' conditions to the '2026 with scheme', the greatest increase in noise level is predicted to be 1.9dB for Gavray Drive west of A4421. This is considered to represent a negligible impact in the long-term, and therefore a **neutral** effect, in accordance with the significance criteria set-out in this Chapter.

10.5.18 No specific mitigation is required with regards to development-generated road traffic noise from the Proposed Development.

Environmental Noise Levels at Proposed Development

10.5.19 Noise modelling has been carried out using CadnaA Software.

10.5.20 For the assessment, 2026 predicted baseline road traffic information was used.

10.5.21 The available train information for 2035 was used in order to accurately show the future predicted noise levels at the façade of the new proposed residential receptors.

10.5.22 Free field and façade noise levels have been predicted across the site.

10.5.23 Figure 10.1 shows the predicted noise levels across the site as a result of rail and road noise. Noise levels are calculated at 1.5 meters above ground with ground absorption set to 80%.

Figure 10.2 Road and rail noise levels across the site (daytime)

Figure 10.3 Road and rail noise levels across the site (night time)

10.5.24 Noise levels at the proposed private garden areas are not generally predicted to exceed 55 dB L_{Aeq} during daytime hours and most will not exceed 50 dB L_{Aeq} with the proposed massing design affording screening to those amenity spaces screened by continuous frontages to the north east.

10.5.25 Referring to Table 10.13 this would result in a **Negligible** to **Low** impact in the amenity spaces.

10.5.26 Façade dB $L_{Aeq, T}$ noise levels have been predicted. The highest façade levels, predicted at each floor of each building, are presented in Figures 10.4 to 10.7.

10.5.27 Façade night time dB L_{AMAx} noise levels have been predicted. The highest façade levels, predicted at each floor of each building, are presented in Figures 10.8 for the eastern area of the site.

Figure 10.4 Daytime noise levels incident on the development- west site

Figure 10.5 Daytime noise levels incident on the development-east site

Figure 10.6 Night time ambient noise levels incident on development-west site

Figure 10.7 Night time ambient noise levels incident on development-east site

Figure 10.8 Night time maximum noise levels incident on development- east site

10.5.28 It is clear that facades overlooking the railway will need specific mitigation to control internal maximum and ambient noise levels, particularly at night. The layout of the site has been optimised to attenuate noise across most of the site through the use of higher density "barrier blocks" close to the railway which provide shielding to homes and gardens further back. However, these barrier blocks in particular will require considered layout and building envelope sound insulation measures to provide suitable internal acoustic conditions. Specific design detail requirements are provided in the Mitigation Section of this Chapter.

Rail Vibration Impact Assessment

Vibration Dose Values

10.5.29 The estimated changes in vibration level for different building constructions is described in the ANC Guidelines Measurement & Assessment of Groundborne Noise & Vibration2. For this assessment the highest results have been multiplied by a factor of two in order to represent the worst case internal VDVs within dwelling.

10.5.30 There is a low probability of adverse comment even based on the highest measured VDV (0.02ms-1.75) at the measurement locations and considering the potential for greater vibration magnitude within dwellings.

10.5.31 Due to the noise concerns, dwellings will be constructed at a significantly greater distance from the railway line than the vibration measurement location. Therefore, vibration levels within the proposed dwellings will be lower than measured close to the railway.

Re-Radiated Noise

10.5.32 A typical design target for re-radiated sound from railway-induced vibration is 35 dB LASmax in habitable rooms. Re-radiated sound within typical dwellings can be estimated using the equation below:

$$L_p = L_v - 27$$

Where:

- L_p (dB reference 20 µPa) is the predicted sound pressure level (L_{ASmax})
- L_v (dB reference 1 nm/s) is the measured RMS velocity

10.5.33 In lieu of RMS velocity levels, the highest typical Peak Particle Velocity (PPV) in each direction during the daytime and night-time have been utilized to provide a worst-case assessment.

Table 10.19 presents the results of the assessment.

Table 10.18: Assessment of Re-Radiated Sound

Description of Parameter	X-axis	Y-axis	Z-axis
Highest Measured Peak Particle Velocity (mm/s)	0.51	0.59	0.78
Predicted Re-Radiated Sound Level (dB)	27	28	31
Below Target Criterion? (35 dB L_{ASmax})	✓	✓	✓

10.5.34 Predicted levels of re-radiated sound will be below the target of 35 dB L_{ASmax}. Therefore, mitigation measures to reduce re-radiated sound will not be required.

10.6 MITIGATION MEASURES

Construction stage

10.6.1 In order to reduce the potential impact of noise generated by the construction phase of the proposed Development at existing sensitive receptors, mitigation measures will be required. A best practicable means approach should be implemented.

10.6.2 The construction works would follow the guidelines in BS5228-1 and the guidance in BRE Controlling particles, vapour and noise pollution from construction sites, Parts 1 to 5, 2003. The following measures will be put in place to minimise noise emissions and implemented via a Construction Environmental Management Plan (CEMP):

- When works are taking place within close proximity to the sensitive receptors identified, the screening of noise sources via the erection of temporary screens will be employed;
- All machinery will be regularly maintained to control noise emissions, with particular emphasis on lubrication of bearings and the integrity of silencers;
- Site staff will be made aware that they are working adjacent to a sensitive area and avoid all unnecessary noise due to misuse of tools and equipment, unnecessary shouting and radios;
- As far as possible, the avoidance of two noisy operations occurring simultaneously in close proximity to the same sensitive receptor;
- Adherence to any time limits imposed on noisy works by the local authority;
- Implement set working hours during the week and at weekends;
- Ensure engines are turned off when possible; and
- Should demolition and construction activities need to be carried out during night-time hours, the local authority may include a planning condition that requests advance notice and details of any night working to provided.

10.6.3 BS5228-2 recognises that the most common form of vibration associated with piling is the intermittent type derived from conventional driven piles. Whilst it is recognised that the piling process would need to be selected on the basis of the strata to be encountered, the loads to be supported and the economics of the system, careful consideration (by the appointed developer(s)) would be given to the type of piling to be used in order to minimise the potential for significant noise and vibration impacts.

10.6.4 The receptors likely to be affected by piling would vary over the course of the Proposed Development under construction. Once the precise building locations and ground conditions

for each location and type(s) of piling are confirmed, vibration levels would be estimated and recommendations for control made as appropriate.

10.6.5 To keep ground borne vibration to a minimum the following measures (as referred to in BS5228-2) would be put in place:

- Substitution: Where reasonably practicable, plant and or methods of work likely to cause significant levels of vibration at the receptors identified would be replaced by less intrusive plant/methods of working; and
- Isolation of plant at source: This may prove a viable option where the plant is stationary (e.g. a compressor, generator) and located close to a receptor.

10.6.6 There are a number of measures that can be implemented, depending upon the type of piling chosen (e.g. continuous flight auger (CFA) piling produces significantly less vibration than conventional driven piling and, therefore, fewer mitigation measures would be required if CFA piling were chosen as the preferred method). Additionally, the distance between the piling rig and the receptors has a significant bearing upon the likely impact. The vibration produced by piling is transient and only occurs in any one location for a limited period of time.

10.6.7 BS5228-2 indicates that mitigation might include the use of alternative methods, removal of obstructions, provision of cut-off trenches, reduction of energy input per blow, reduction of resistance to penetration. As the construction programme and methodologies become more defined, earthworks and construction vibration would be reviewed and a more detailed strategy for control would be devised and implemented via the CEMP.

10.6.8 Continuous Flight Auger (CFA) or other augured form of piling should be used in place of driven piles where possible. If driven piles (including vibratory sheet piles) are required within 30m or existing receptors then the following is advised:

- Inform all affected residents of the need for piling, the times when it will be carried out and the duration;
- Carry out vibration monitoring at or close to receptors while piling is taking place. The monitoring methodology should identify actions necessary when specific thresholds are exceeded.

Operational Phase Noise Impact on Existing Receptors

10.6.9 No adverse effects are predicted to occur when the Site becomes operational, therefore no specific mitigation is required.

Noise levels at proposed development

Noise Barrier

10.6.10 Calculations included in this assessment assume a noise barrier will be installed to the north eastern site boundary prior to elevation of the railway at the footbridge.

10.6.11 The barrier shall be a minimum of 3.5m to provide effective noise mitigation to proposed dwellings and be no less than 10kg/m^2 surface mass.

Building Fabric Design

10.6.12 With reference to Figures 10.4 to 10.8, the higher noise exposure category resulting from either maximum or ambient noise levels shall take priority with regards to prescribed mitigation measures.

10.6.13 Detailed noise break-in calculations for each house type and habitable room type have been carried out in order to determine glazing and ventilation requirements for dwellings

10.6.14 At this stage of the project, detailed information has not yet been developed regarding façade construction, and ventilation strategy etc. The guidance contained herein is therefore subject to development during technical design.

10.6.15 The recommended outline mitigation measures to control noise ingress into new dwellings are presented in Table 10.20, below.

Table 10.19 Mitigation for Proposed Sensitive Uses

Façade Noise Exposure Category	External Ambient Noise levels at the façade dB $L_{Aeq, T}$	Short term "event" Maximum Night Time Noise Levels at the façade dB L_{AFMax}	Design Mitigation
High	Daytime: >60 dB Night time: >55 dB	>75	Orientate corridors, stairwells and ancillary non-sensitive spaces (i.e WC, bathrooms and kitchen) towards high noise exposure level facades. Avoid bedrooms on facades with high noise exposure. Suitable high performance acoustic laminate double glazing (e.g 46dB R_w) and mechanical ventilation should be provided to control normal maximum noise levels to <45dB L_{AFMax} internally at night. Ventilation systems and thermal design should avoid the need to open windows to control overheating, except in extreme circumstances. Window area should not exceed 1m^2 for a typical bedroom of volume 27-36m^2
Moderate	Daytime: <=60 dB Night time: <=55 dB	65-75	Avoid bedrooms on facades with these noise levels incident where possible. Suitable acoustic double glazing and acosutic trickle vents should be provided to control normal maximum noise levels to <45dB L_{AFMax} internally at night. Ventilation systems and thermal design should minimise need to open windows as far as possible in line with assessment with guidance contained within the AVO (Acoustics, ventilation and overheating guide).
Low	Daytime: <=50 dB Night time: <=45 dB	<65dBA*	No specific mitigation, standard double-glazing and "Mode 3" ventilation under Building Regulations Part F

*Assumes that "reasonable conditions" in accordance with BS8233:2014 are acceptable.

10.6.16 The category value for each façade has been determined based on detailed noise break-in calculations.

10.6.17 In addition to the above where external noise levels incident at the proposed dwellings are in the high noise exposure category, window will need to remain closed most of the time, and therefore thermal and ventilation design should seek to provide comfortable temperatures without opening windows.

10.6.18 In addition, it would also clearly be advantageous for apartments to feature a dual aspect to allow for ventilation via the less noise exposed facades and to facilitate residents having openable windows without significant noise exposure.

10.7 RESIDUAL EFFECTS

Construction stage

10.7.1 With the inclusion of mitigation measures, noise associated with construction of the Site is likely result in **neutral** effects, however there is potential for short-term **moderate** effects when construction takes place in the immediate vicinity of sensitive receptors.

10.7.2 With the inclusion of mitigation measures, vibration associated with construction of Site is likely result in **neutral** effects.

10.7.3 Assuming piling can be avoided, or augured piling is used, it is unlikely that vibration from construction activities would exceed the threshold of **negligible** significance at existing receptors. If driven piles are necessary close to existing receptors it is likely that vibration will cause complaint, but this can be tolerated if prior warning and explanation has been given to residents. The potential for building damage can be effectively mitigated through continuous vibration monitoring during piling. This will result in **neutral** effects.

Post-completion stage

10.7.4 The assessment of development generated road traffic associated with the Site, indicates that associated noise effects will be **neutral**.

10.7.5 Providing noise is controlled to the recommended noise limits included in the Chapter noise from proposed ancillary equipment will have a neutral effect

Noise levels at proposed development

10.7.6 With the inclusion of 2m high garden wall/fencing, together with the glazing and ventilation strategy outlined in the Chapter, residual effects at proposed residential dwellings will be **Minor**.

Summary of effects

10.7.7 The effects identified are summarised in **Table 10.22** below:

Table 10.20: Summary of effects

Potential effect	Significance (pre-mitigation)	Mitigation measure	Significance of residual effect
Construction Phase Impact			
	Low (Potentially moderate during access road construction)	CEMP	**Negligible to Minor**
Operational Phase Impact			
Road traffic increase	**Negligible**	No further mitigation proposed	**Negligible**
Proposed Sensitive Receptors			
Road and rail noise	**High** **(Low for garden areas)**	Ventilation and façade build up. Garden fences	**Negligible to Minor**

10.8 CUMULATIVE EFFECTS

10.8.1 The noise and vibration impact of the PD is expected to be negligible in the operational phase. Therefore, the PD will not contribute significantly to the cumulative impact resulting from the PD and any other planned developments post -construction.

10.8.2 The impact on the proposed development resulting from the new train schedule in 2035 is considered within the mitigation recommendations outlined in Section 10.6.

10.8.3 If construction works associated with the train line coincide with construction works on the PD site, noise levels may temporarily be higher than assessed in this chapter. This could be managed by scheduling PD construction to avoid works closest to sensitive receptors affected by both sites.