M42 Junction 6 Improvement
Scheme Number TR010027
Volume 6
6.1 Environmental Statement
Chapter 12 – Noise and Vibration

Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

January 2019

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

M42 Junction 6 Improvement Development Consent Order 202[ ]

6.1 Environmental Statement
Chapter 12 – Noise and Vibration

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12 Noise and vibration

12.1 Competent expert evidence

12.1.1 This chapter presents the results of an assessment of potential noise and vibration effects during the construction and operation of the Scheme.

12.1.2 This assessment has been undertaken and reported by a competent expert within AECOM, the quality and completeness of which has been approved by a Regional Director who is a Chartered Member of the Institute of Acoustics (MIOA).

12.1.3 They have 25 years of experience in environmental acoustics and contribute to, and manage, noise and vibration assessments for a wide range of projects including experience in transportation, residential, commercial and industrial assessments. They possess a detailed knowledge of noise and vibration assessments applied to a large scale highway schemes, having worked on a number of projects and acted as a technical expert at Public Inquiries.

12.2 Legislative and policy framework

12.2.1 The following legislation and planning policy is of direct relevance to the assessment of noise and vibration.

12.2.2 Compliance with statute and policy relating to noise and vibration is addressed within the Planning Statement **[TR010027/APP/7.1].**

National Policy Statement for National Networks

12.2.3 Paragraphs 5.186 to 5.200 of the National Policy Statement for National Networks (NPSNN) [REF 12-1] deals with noise and vibration. It states that excessive noise can have wide ranging impacts on the quality of human life and health, use and enjoyment of areas of value (such as quiet places) and areas with high landscape quality. It also notes that similar considerations apply to vibration.

12.2.4 The NPSNN [REF 12-1] states that operational noise and vibration, with respect to human receptors, should be assessed using the principles of the relevant British Standards and other guidance. For the prediction, assessment and management of construction noise and vibration, reference should be made to any relevant British Standards and other guidance, which also give examples of mitigation strategies.

12.2.5 The NPSNN [REF 12-1] states that noise from a proposed development can also have adverse impacts on wildlife and biodiversity, and that noise effects of a proposed development on ecological receptors should be assessed in accordance with the paragraphs 5.20 to 5.38 of the NPSNN [REF 12-1].

12.2.6 With respect to decision making, the NPSNN [REF 12-1] states that developments must be undertaken in accordance with statutory requirements for noise and that due regard must have been given to the relevant sections of the DEFRA Noise Policy Statement for England (NPSE) [REF 12-2], the National Planning Policy Framework (NPPF) [REF 12-3] and the Government's associated planning guidance on noise.

12.2.7 It states that the Secretary of State should not grant development consent unless satisfied that the proposals will meet the following aims, within the context of Government policy on sustainable development:

a. avoid significant adverse impacts on health and quality of life from noise as a result of the new development;

b. minimise and mitigate other adverse impacts on health and quality of life from noise from the new development; and

c. contribute to improvements to health and quality of life through the effective management and control of noise, where possible.

12.2.8 These three aims echo those which support the long term vision in the NPSE [REF 12-2].

Noise Policy Statement for England

12.2.9 The NPSE [REF 12-2] sets out the long term vision of the Government's noise policy, which is to "promote good health and a good quality of life through the effective management of noise within the context of policy on sustainable development". This long term vision is supported by the three aims, as listed under the NPSNN [REF 12-1], and is designed to enable decisions to be made regarding what is an acceptable noise burden to place on society.

12.2.10 The Explanatory Note contained within the NPSE [REF 12-2] introduces the following concepts to aid in the establishment of significant effects:

a. No Observed Effect Level (NOEL): the level below which no effect can be detected. Below this level no detectable effect on health and quality of life due to noise can be established.

b. Lowest Observable Adverse Effect Level (LOAEL): the level above which adverse effects on health and quality of life can be detected.

c. Significant Observed Adverse Effect Level (SOAEL): the level above which significant adverse effects on health and quality of life occur.

12.2.11 The NPSE [REF 12-2] recognises that *"it is not possible to have a single objective noise-based measure that is mandatory and applicable to all sources of noise in all situations"*. The levels are likely to be different for different noise sources, for different receptors and at different times of the day.

National Planning Policy Framework

12.2.12 The NPPF [REF 12-3] sets out the Government's planning policies for England and how these are expected to be applied. The Framework supersedes guidance contained in Planning Policy Guidance 24: Planning and Noise [REF 12-4].

12.2.13 The Framework provides for the production of distinctive local and neighbourhood plans by local authorities, in consultation with local people, which should be developed to reflect the needs and priorities of their communities.

12.2.14 Applications for planning permission must be determined in accordance with the local authority development plan (which includes any local plan or neighbourhood plans which have been adopted for the area), unless material considerations indicate otherwise. The NPPF [REF 12-3] must be taken into account in the preparation of local and neighbourhood plans, and is a material consideration in the determination of planning applications. Planning policies and decisions must also reflect, and where appropriate promote, relevant EU obligations and statutory requirements.

12.2.15 The planning system is required to contribute to and enhance the natural and local environment. Consequently, the aim is to prevent both new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of noise pollution.

12.2.16 Paragraph 170 of the NPPF [REF 12-3] states that *"planning policies and decisions should contribute to and enhance the natural and local environment by…preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans."*

12.2.17 Paragraph 180 of the NPPF [REF 12-3] states that *"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should…mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development - and avoid noise giving rise to significant adverse impacts on health and the quality of life [and] identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason"*.

12.2.18 With regards to adverse impacts and significant adverse impacts, the NPPF [REF 12-3] refers to the NPSE Explanatory Note [REF 12-2].

Planning Practice Guidance

12.2.19 Planning Practice Guidance for Noise [REF 12-5] is a web-based resource that supports the NPPF [REF 12-3], and advises that local planning authorities should consider:

a. whether or not a significant adverse effect is occurring or likely to occur;

b. whether or not an adverse effect is occurring or likely to occur; and

c. whether or not a good standard of amenity can be achieved.

12.2.20 This guidance introduces the additional concepts of No Observed Adverse Effect Level (NOAEL) and Unacceptable Adverse Effect Level (UAEL).

12.2.21 Factors to be considered in determining if noise is a concern are identified, including the absolute noise level of the source, the existing ambient noise climate, time of day, frequency of occurrence, duration, character of the noise and cumulative impacts.

The Environmental Noise (England) Regulations 2006

12.2.22 These regulations implement the Assessment and Management of Noise Directive 2002/49/EC (known as the Environmental Noise Directive - END) [REF 12-6]. Under the END [REF 12-6], strategic noise mapping of major roads, railways, airports and agglomerations has been completed across the UK, including the M42 Junction 6, M6, A45, A552 and A41. The results of Round 2 of the noise mapping process were released to Highways England (formerly Highways Agency) in 2014.

12.2.23 The aims of the END [REF 12-6] are to define a common approach in order to avoid, prevent or reduce the harmful effects of environmental noise. Four 'Noise Important Areas' (NIA) (i.e. those areas most exposed to noise) have been identified from the Round 2 strategic noise mapping process within 1km of the Scheme, and are detailed in **Table 12.1** and shown on Figure 12.1 [**TR010027/APP/6.2**].

Table 12.1: Noise important areas within 1km of the Scheme

NIA code	Location	Responsible authority
7482	Adjacent to M42	Highways England
7481	Adjacent to M42 Junction 6	Highways England
7483	M42 near Junction 5*	Highways England
2831	Adjacent to A45	Solihull Metropolitan Borough Council (SMBC)

** This is located just outside the 1km study area adopted in the assessment*

12.2.24 Highways England is responsible for assessing the potential for cost effective noise mitigation measures to be implemented in the NIA around M42 Junction 6. The Important Area on the A45 Coventry Road (A45) is the responsibility of the local highways authority, SMBC.

Highways England Policy

12.2.25 The Road Investment Strategy (RIS) [REF 12-7] states that Highways England aspires to be a better neighbour to communities, such that by 2040 over 90% fewer people will be impacted by noise from the strategic road network (SRN).

12.2.26 The Highways England Delivery Plan (2015-2020) [REF 12-8] reiterates that the Government has challenged Highways England to mitigate noise in at least 1,150 NIA over Road Period 1 (2015/2016 to 2019/2020).

12.2.27 Highways England's Licence [REF 12-9] includes a number of general requirements including ensuring that protecting and enhancing the environment is embedded into its business decision-making processes; ensuring the best practicable environmental outcomes are achieved, while working in the context of sustainable development and delivering value for money; and considering the cumulative environmental impact of its activities across its network.

Land Compensation Act 1973

12.2.28 In general, noise and vibration are recognised as both a common law nuisance (either private or public) and a statutory nuisance. However, this does not apply to noise and vibration from road traffic. As a result, the Land Compensation Act 1973 [REF 12-10] and the Noise Insulation Regulations 1975 (as amended) [REF 12-11] (NIR) are used in respect of road traffic noise.

12.2.29 Part I of the Land Compensation Act 1973 [REF 12-10] provides a means by which compensation can be paid to owners of land or property which has experienced a loss in value caused by the use of public works, such as new or altered roads. Noise and vibration are two of the factors which would be considered in any claims for compensation; however the claim should consider all changes and effects, including betterment.

Noise Insulation Regulations 1975

12.2.30 The NIR [REF 12-11] were made under Part II of the Land Compensation Act 1973 [REF 12-10].

12.2.31 Regulation 3 imposes a duty, and Regulation 4 a discretionary power, on the relevant Highway Authority to undertake or make a grant in respect of the cost of undertaking noise insulation work in eligible buildings affected by a new or altered highway. This is subject to meeting a range of criteria relating to road traffic noise levels and distance from the works, as specified in the NIR [REF 12-11].

12.2.32 Regulation 5 also provides discretionary powers to undertake or make a grant in respect of the cost of undertaking noise insulation work in eligible buildings with respect to construction noise.

Control of Pollution Act 1974

12.2.33 Under Section 60 of the Control of Pollution Act 1974 (CoPA) [REF 12-12] the local authority can serve a notice specifying how construction works should be carried out, including working hours and noise/vibration limits. Breaching the terms of the notice is an offence.

12.2.34 Section 61 of the CoPA can be used by the contractor completing demolition or construction works to apply in advance to the local authority for ‘prior consent’.

Solihull Local Plan: Shaping a Sustainable Future

12.2.35 Paragraph 10.12.7 of the adopted Solihull Local Plan: Shaping a Sustainable Future [REF 12-13] states that:

“The Council recognises the existence of significant sources of noise or potential noise within the Borough, such as Birmingham Airport, major roads and railways, mineral workings and some industrial processes, and the need to protect noise sensitive uses, including housing, education and health institutions. The policy seeks to ensure that noise and vibration are contained by appropriate design and operational measures.”

12.2.36 Paragraph 12.2.2 states:

"The main elements identified as having significant impacts on health are: […]

Transport: It is suggested that transport is a significant challenge to public health in terms of road traffic injuries, physical inactivity, community severance and noise and air pollution. However, it also allows access to work, education, social networks and services that can improve people's opportunities"

12.3 Assessment methodology

Scope of the assessment

12.3.1 A scoping exercise was undertaken in late 2017 to identify the matters to be covered by the noise and vibration assessment and agree the approach with relevant statutory bodies.

12.3.2 The process identified that the Scheme could potentially result in adverse noise and vibration impacts during both construction and operation, and identified that a 'detailed' assessment should be undertaken based upon the alignment of the Scheme, the proximity of noise sensitive receptors (NSRs) and the potential for the noise change thresholds to be exceeded, in line with guidance contained in the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 7, HD 213/11 - Revision 1 [REF 12-14].

12.3.3 The outcomes of the scoping exercise were recorded in a scoping report [REF 12-15], which was consulted upon as part of a formal request to the Planning Inspectorate (the Inspectorate) for a scoping opinion.

12.3.4 The Inspectorate's scoping opinion [REF 12-16] identified a number of additional overarching EIA and topic-specific matters that were subsequently brought into the overall scope of this assessment. These further considerations are detailed in Appendix 5.3 [**TR010027/APP/6.3**], which includes a summary of how Highways England has responded to the points raised and where the relevant information is presented within this chapter and elsewhere in this Environmental Statement.

12.3.5 Since undertaking the scoping exercise, the construction assessment impact/significance criteria contained in the scoping report [REF 12-15] have been updated to reflect latest practice. The sensitivity of receptors table contained in the scoping report [REF 12-15] has also not been included in this assessment, as the SOAELs and LOAELs have been set at the same level for all noise/vibration sensitive receptors.

12.3.6 In addition, the scoping opinion [REF 12-16] queried the level of sensitivity of the National Exhibition Centre (NEC), which was rated in the scoping report as 'medium' as it is a multi-use facility. However, as described in paragraph 12.3.4 the sensitivity of receptors scale has been removed from this assessment based on latest guidance and the SOAELs and LOAELs defined equally for all sensitive receptors including the NEC.

12.3.7 An assessment of operational road traffic noise and vibration has been undertaken following the methodology for a detailed assessment, as described in DMRB [REF 12-14] with due regard given to the NPSNN [REF 12-1] and the aims of the NPSE [REF 12-2].

12.3.8 Although not covered in the scoping report [REF 12-15], an assessment of the noise impacts associated with the proposed reconfiguration of the sports pitches, car park and club building at the Warwickshire Gaelic Athletic Association (WGAA) facility has been undertaken.

12.3.9 As the High Speed 2 (HS2) Birmingham Interchange Station would be operational by 2038, the assessment has taken account of the new road layout forming part of this development. This new road layout has been based on the 2-dimensional information for this development available at the time of undertaking the assessment, overlaid onto existing topographical data.

12.3.10 Consideration was given to the activities associated with the future maintenance and management of the Scheme, and whether these have the potential to result in significant effects on noise and vibration. Following a review of the maintenance activities presented in Chapter 3 The project, it was concluded that there would be limited potential of such effects to occur, and that these activities are comparable with standard maintenance operations already being undertaken elsewhere on the strategic and local road networks. Accordingly, the effects associated with this phase of the Scheme were scoped out of the assessment and are not considered further.

Assessment guidance

12.3.11 Guidance contained in the DMRB [REF 12-14] has been used to inform the scope and content of the assessment, and to assist the identification and mitigation of likely significant effects. This builds upon the overarching EIA methodology and guidance presented in Chapter 5 EIA methodology and consultation.

12.3.12 Further guidance and standards used in the assessment is described within the following sections.

Establishment of the baseline

12.3.13 To inform the assessment a baseline noise survey was completed in March 2018 at nine locations, using Scheme design information contained within the November 2017 Design Fix (see Chapter 3 The project).

12.3.14 The main purpose of the baseline noise survey was to assist with developing an understanding of the general noise climate along the Scheme. For example, to identify if any other local noise sources (other than road traffic) are present and contribute significantly to the local noise climate.

12.3.15 The nine noise monitoring locations are detailed on **Figure 12.1** [**TR010027/APP/6.2**]. The locations were chosen to be representative of NSRs across the Scheme and were agreed with the Environmental Health Officer (EHO) at SMBC.

12.3.16 The data collected as part of the survey was used to validate the noise model.

12.3.17 Initial discussions were held with the EHO at SMBC in October 2017 and February 2018 to discuss the approach to the noise and vibration assessment (including the proposed methodology for the baseline noise survey), as presented in the scoping report [REF 12-15], and to gather information relating to:

a. local noise sources other than road traffic (i.e. rail and aircraft at Birmingham Airport);

b. any receptors requiring particular attention (none identified, although it was noted that residents in Church Lane had raised concerns about noise from recent works on a nearby bridge); and

c. any local concerns that SMBC is aware of (no known sources of noise or vibration complaint in the area).

12.3.18 SMBC's EHO was satisfied with the proposed noise monitoring locations and methodology.

12.3.19 Further consultation was undertaken with SMBC's EHO to agree the assessment methodology and criteria relating to the assessment of the reconfiguration of the WGAA facility.

12.3.20 Within the scoping opinion [REF 12-16], the Canal and River Trust identified potential for impacts on the Grand Union Canal and its associated receptors resulting from noise. As a small section of the canal near Catherine-de-Barnes falls within the 600m traffic noise calculation area, this has accordingly been considered in the operational impact assessment.

12.3.21 NSRs have been identified by type, using classifications contained within digital Ordnance Survey (OS) Address Base data (see Section 12.4).

Sensitivity of the noise and vibration environment

Construction assessment

12.3.22 A quantitative assessment of construction noise and vibration impacts has been undertaken. At this stage, before contractors have been appointed to construct the Scheme, precise information on the construction works is not available. However, a buildability advisor has been appointed to provide reasonable assumptions on the likely works. Therefore, the estimated construction noise and vibration levels are based on reasonable worst case information which includes the number and type of plant likely to be required for each activity, typical 'on' times for each item of plant, working areas, working times and durations. Further details on the activities and plant throughout the construction works are provided in Appendix 12.1 [**TR010027/APP/6.3**].

12.3.23 Estimates of reasonable worst case construction noise and vibration levels have been made for a selection of 16 of the closest identified potentially sensitive receptors to the works, illustrated in **Figure 12.1** [**TR010027/APP/6.2**]. These selected receptors are also representative of neighbouring properties in their vicinity. By choosing a selection of the closest identified potentially sensitive receptors the reported impacts are, therefore, typical of the worst affected receptors and all potentially significant effects are identified. At receptors further away from the works the impacts would be less. Reasonable worst case construction noise and vibration levels have been estimated in accordance with the methodology in BS 5228:2009 + A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites: Part 1: Noise [REF 12-17] and Part 2: Vibration [REF 12-18].

Construction noise assessment

12.3.24 BS 5228 [REF 12-17] contains a number of example methodologies for identifying significant construction noise effects based on fixed thresholds or noise level changes. For the purposes of this assessment the 'ABC' method has been adopted. This approach is based on setting the threshold for the onset of potentially significant adverse effects (i.e. the SOAEL, as defined in paragraph 12.2.10) depending on the existing ambient noise level. Receptors with low existing ambient noise levels (Category A) have a lower threshold than those with high existing ambient noise levels (Category C). Higher thresholds are set for normal daytime construction working hours, compared to the more sensitive evening/weekend and night time periods. As a conservative approach, the threshold for the onset of adverse effect (i.e. the LOAEL, as defined in paragraph 12.2.10) is set at a construction noise level equal to the existing ambient. Construction noise levels between the LOAEL and the SOAEL have the potential to result in adverse effects but would not normally be classed as significant adverse effects. However, noise mitigation measures are still considered in such locations to seek to keep all effects to a minimum. **Table 12.2**, which is adapted from Table E.1 in BS 5228 [REF 12-17], sets out the construction noise SOAELs and LOAELs used for this assessment.

Table 12.2: Construction Noise SOAEL and LOAEL for all receptors

Time of day	SOAEL $L_{Aeq,T}$ dB (façade)			LOAEL $L_{Aeq,T}$ dB (façade)
	A[1]	B[2]	C[3]	
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75	Existing ambient
Evenings (19:00 – 23:00 weekdays) and Weekends (13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays)	55	60	65	Existing ambient
Night-time (23:00 – 07:00)	45	50	55	Existing ambient

[1] Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values

[2] Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as the category A values

[3] Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than the category A values

NOTE: if the ambient noise level exceeds the Category C threshold values then the SOAEL and LOAEL are defined as equal to the existing ambient

12.3.25 The ambient noise levels (and resultant SOAEL and LOAEL) at the relevant façade of each of the selected receptors have been determined based on predicted 2016 baseline traffic noise[1] levels.

[1] 2016 is the base year traffic data used in the assessment.

12.3.26 Construction traffic noise impacts along existing roads have been estimated based on the Calculation of Road Traffic Noise (CRTN) [REF 12-19] methodology for the calculation of the Basic Noise Level (BNL) at a reference distance of 10m from the nearside carriageway. Predictions have been undertaken for both the 'with' and 'without' construction traffic scenarios in 2021, which is the peak construction year, for each road link in the construction traffic model.

Construction vibration assessment

12.3.27 The construction of the Scheme has the potential to result in temporary noise impacts at the closest receptors to the works. The potential for temporary construction vibration impacts is dependent on the need for construction activities which are a potentially significant source of vibration, such as impact piling, ground improvement and road construction (pavement) works using vibratory rollers/compactors.

12.3.28 Vibration levels have been estimated in accordance with the relevant methodologies in BS 5228 [REF 12-18]. It is standard practice to consider vibration impacts from construction works up to a maximum distance of 100m from the works, as no impact would be anticipated beyond this.

12.3.29 The transmission of ground-borne vibration is highly dependent on the nature of the intervening ground between the source and receptor and the activities being undertaken. BS 5228 [REF 12-18] provides data on measured levels of vibration for various construction works. Impacts are considered for both damage to buildings and annoyance to occupiers.

12.3.30 Guidance on the effects of construction vibration in terms of building damage is provided in BS 7385:1993 Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration [REF 12-20]. It provides guidance on vibration levels likely to result in cosmetic damage, and is referenced in BS 5228 [REF 12-18]. Limits for transient vibration, above which cosmetic building damage could occur, are given in **Table 12.3**.

Table 12.3: Transient vibration guide values for cosmetic damage

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

12.3.31 BS 7385-2 [REF 12-20] states that the probability of building damage tends to be zero for transient vibration levels less than peak particle velocity (ppv) of 12.5mms^{-1} (millimetres per second). For continuous vibration the threshold is around half this value. It is also noted that these values refer to the likelihood of cosmetic damage. ISO 4866:2010 [REF 12-21] defines three different categories of building damage:

a. cosmetic: formation of hairline cracks in plaster or drywall surfaces and in mortar joints of brick/concrete block constructions;

b. minor: formation of large cracks or loosening and falling of plaster or drywall surfaces or cracks through brick/block; and

c. major: damage to structural elements, cracks in support columns, loosening of joints, splaying of masonry cracks.

12.3.32 BS 7385-2 [REF 12-20] indicates that minor damage occurs at a vibration level twice that of cosmetic damage, and that major damage occurs at a vibration level twice that of minor damage. Therefore, this guidance can be used to define the potential impact identified in **Table 12.4** for continuous vibration.

Table 12.4: Construction vibration criteria for assessing building damage

Damage risk	Continuous vibration level ppv mms^{-1}
Major	>=30
Minor	15 to <30
Cosmetic	6 to < 15
Negligible	< 6

12.3.33 BS 5228 [REF 12-19] provides guidance on the impact of construction vibration in terms of annoyance, focussing on residential properties. The vibration levels and associated effects stated in BS 5228 [REF 12-19] are provided in **Table 12.5**.

Table 12.5: Construction vibration criteria for human receptors (annoyance)

Annoyance	Continuous vibration level ppv mms^{-1}
Vibration is likely to be intolerable for any more than a very brief exposure to this level.	>= 10
It is likely that vibration of this level in residential environments will cause complaints, but can be tolerated if prior warning and explanation has been given to residents.	1.0 to < 10
Vibration might be just perceptible in residential environments.	0.3 to < 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.	0.14 to < 0.3

12.3.34 For human receptors the LOAEL is defined as a ppv of 0.3mms^{-1}, this being the point at which construction vibration is likely to become perceptible. The SOAEL is defined as a ppv of 1.0mms^{-1}, this being the level at which construction vibration can be tolerated with prior warning.

Operational traffic noise assessment

12.3.35 The general principle of DMRB [REF 12-14] is to allocate an assessment method according to risk. This process uses three levels of assessment: scoping; simple; and detailed. The assessment level used for this Scheme is detailed, as the Scheme is considered to have the potential to result in significant changes in traffic noise.

12.3.36 Noise from a flow of road traffic is generated by both the vehicle engines and the interaction of tyres with the road surface. The traffic noise level at a receptor, such as an observer at the roadside or residents within a property, is influenced by a number of factors including traffic flow, speed, composition (percentage of heavy duty vehicles (HDV)), gradient, type of road surface, distance from the road and the presence of any obstructions between the road and the receptor.

12.3.37 Noise from a stream of traffic is not constant, but to assess the noise impact a single figure estimate of the overall noise level is necessary. The index adopted by the Government in CRTN [REF 12-19] to assess traffic noise is $L_{A10,18h}$. This value is determined by taking the highest 10% of noise readings in each of the 18 one-hour periods between 06:00 and 00:00, and then calculating the arithmetic mean. As recorded in DMRB [REF 12-14], a reasonably good correlation has been shown to exist between this index and the perception of traffic noise by residents over a wide range of noise exposures.

12.3.38 CRTN [REF 12-19] provides the standard methodology for predicting the $L_{A10,18h}$ road traffic noise level. Noise levels are predicted at a point measured 1m horizontally from the external façade of buildings. The methodology applies a 'low flow' correction between 18-hour flows of 1,000 and 4,000. The low flow correction procedure amplifies the impact of changes in traffic flows which are already low, in particular at receptors very close to the road. The 1,000 18-hour flow cut off is the lower limit of the prediction methodology.

12.3.39 Although the main focus of the assessment is on daytime impacts, DMRB [REF 12-14] also requires an assessment of night-time traffic noise levels using the parameter $L_{night,outside}$, which is the traffic noise level over the period 23:00 to 07:00. However, this parameter is not calculated by the standard CRTN [REF 12-19] methodology. DMRB [REF 12-14] refers to three methods for calculating night-time traffic noise levels developed by the Transport Research Laboratory (TRL) [REF 12-22]. The most widely used is 'Method 3' which factors the $L_{night,outside}$ from the $L_{A10,18h}$, based on the typical diurnal pattern of traffic flows in the UK for motorways and non-motorways. This method has been used in this assessment.

12.3.40 All predicted road traffic noise levels have been calculated using the CadnaA[2] noise prediction software (version 2018), which predicts the $L_{A10,18h}$ traffic noise level at receptor locations in accordance with the CRTN [REF 12-19]. CadnaA models have been built for the do-minimum (DM) and do-something (DS) scenarios for both the Baseline Year (2023) and Future Year (2038). All calculations are based on the predicted traffic flows and % heavy goods vehicle (HGV) for the Baseline Year and Future Year as supplied in the form of 18 Hour Annual Average Weekday Traffic (AAWT) flows. The traffic speeds are subject to a process called 'speed banding', which assigns one of four speeds to all non-motorway roads and one of three speeds for all motorways, as set out in Interim Advice Note (IAN) 185/15: Updated traffic, air quality and noise advice on the assessment of link speeds and generation of vehicle data into 'speed-bands' for users of DMRB [REF 12-23].

12.3.41 DMRB [REF 12-14] also requires consideration of the likely annoyance to residents caused by traffic noise, in both the short and long term. Individuals vary widely in their response to the same level of traffic noise. However, the average or community response from a large number of people to the same level of traffic noise is fairly stable and, therefore, a community average degree of annoyance caused by traffic noise can be related to the long term steady state noise level. In addition, it notes that people are more sensitive to abrupt changes in traffic noise, for example, following the opening of a new road, than would be predicted from the steady state relationship between traffic noise and annoyance. These effects last for a number of years. However, in the longer term, the perceived noise annoyance tends towards the steady-state level due to familiarisation.

12.3.42 The objective of the assessment is to gain an overall appreciation of the noise and vibration climate, both with (DS) and without (DM) the Scheme, to identify where noise impacts occur and to determine where mitigation to reduce these impacts may be appropriate. These conditions are assessed for the baseline year (the year of opening) and the future assessment year (15 years after opening).

12.3.43 DMRB [REF 12-14] outlines the steps to be carried out during the detailed assessment:

a. identify the study area (see Section 12.5) and predict 18-hour (06:00 - 00:00) and night-time (23:00 - 07:00) traffic noise levels at all residential properties within a 600m calculation area around the Scheme, the existing routes bypassed/improved by the Scheme, and 'affected routes' within a defined 1km boundary around the Scheme extents;

b. carry out the following comparisons for each property in order to identify the number of properties where residents may experience an increase or decrease in traffic noise levels and annoyance:

    i. the DM scenario in the Baseline Year against the DM scenario in the Future Year (long term);

[2] Further information regarding CadnaA (Computer Aided Noise Abatement) software can be found at https://www.datakustik.com/products/cadnaa/cadnaa/

ii. the DM scenario in the Baseline Year against the DS scenario in the Baseline Year (short term); and

iii. the DM scenario in the Baseline Year against the DS scenario in the Future Year (long term).

c. for night-time traffic noise levels, comparisons are only required for the two long term scenarios and for properties where the Lnight, outside level is 55dB(A) or more in the relevant scenarios;

d. assess the impact on sensitive receptors, other than residential properties, within the 600m calculation area. This is based on 18-hour (06:00 - 00:00) traffic noise levels and considers the same three comparisons as outlined above for residential properties. Other sensitive receptors include hospitals, schools, community facilities (such as places of worship, educational buildings and hospitals), designated ecological areas such as Areas of Outstanding Natural Beauty, National Parks, Special Areas of Conservation, Special Protection Areas and Sites of Special Scientific Interest (SSSI), public open spaces, scheduled monuments and public rights of way (PRoW);

e. complete a qualitative assessment of sensitive receptors which are within the 1km boundary, but outside the 600m calculation area; and

f. for affected routes which are outside the 1km boundary, calculate the CRTN BNL on these roads (the traffic noise level at 10m) with and without the Scheme. Count the number of dwellings and other sensitive receptors within 50m of these routes.

12.3.44 Different façades of the same property can experience different changes in traffic noise level depending on their orientation to the noise source. DMRB [REF 12-14] requires that each of the above comparisons of traffic noise levels is based on the façade which experiences the least beneficial change i.e. the largest increase, or, if all façades undergo a decrease, the smallest decrease. Additionally, it requires that the above comparisons of annoyance use the highest levels of annoyance in the first 15 years. For properties which experience an increase in noise due to the Scheme, the greatest annoyance is likely to be immediately after the Scheme opens to traffic. For properties which experience a decrease in noise (and also in the DM comparison), the greatest annoyance is the steady-state level of annoyance in the long term.

12.3.45 DMRB [REF 12-14] provides two example classifications for the magnitude of the traffic noise impact, as shown in **Table 12.6** these relate to both short term changes and long term changes in noise levels.

Table 12.6: Classification of magnitude of noise impacts

Magnitude of Impact	Short Term Noise change $L_{A10,18h}$ dB	Long Term Noise change $L_{A10,18h}$ dB
No change	0	0
Negligible	0.1 - 0.9	0.1 - 2.9
Minor	1.0 - 2.9	3.0 - 4.9
Moderate	3.0 - 4.9	5.0 - 9.9
Major	≥5.0	≥10.0

12.3.46 The introduction of recent planning guidance has increased the focus on the consideration of absolute noise levels as well as the change in noise level due to a road scheme. DMRB [REF 12-14] only considers the change in noise level when determining the magnitude of impact of a road scheme. In light of the introduction of the NPPF [REF 12-3] and the NPSE [REF 12-2], a greater consideration of absolute noise levels is considered appropriate, including an acknowledgement that where existing traffic noise levels are high (above the SOAEL as defined below), even small changes in traffic noise in the short term (1dB or more) may be significant.

12.3.47 The SOAEL and the LOAEL for road traffic noise used in this assessment are detailed in **Table 12.7**.

Table 12.7: Traffic noise SOAEL and LOAEL for all receptors

Time period	SOAEL	LOAEL
Daytime	68dB $L_{A10,18h}$ (façade) 63dB $L_{Aeq,16h}$ (free-field)	55dB $L_{A10,18h}$ (façade) 50dB $L_{Aeq,16h}$ (free-field)
Night	55dB $L_{night,outside}$ (free-field)	40dB $L_{night,outside}$ (free-field)

12.3.48 For daytime, the SOAEL is set at 68dB $L_{A10,18h}$ (façade), which is consistent with the daytime trigger level in the NIR [REF 12-11]. For consistency with the NIR [REF 12-11], levels of 67.5dB are rounded up to 68dB. The LOAEL is set at 50dB $L_{Aeq,16h}$ (free-field), based on the information provided in the World Health Organisation (WHO) Guidelines for Community Noise [REF 12-24] regarding the onset of moderate community annoyance. This is broadly equivalent to 55dB $L_{A10,18h}$ (façade) as predicted by CRTN [REF 12-19].

12.3.49 For night-time, the SOAEL is set at 55dB $L_{Aeq,8h}$ (free-field) for residential properties. This aligns with the interim night-time outdoor target level provided in the WHO Night Noise Guidelines for Europe (NNG) [REF 12-25]. The LOAEL is set at 40dB $L_{Aeq,8h}$ (free-field), which is defined as the LOAEL in the NNG.

12.3.50 The road traffic noise SOAEL and LOAEL are used to consider how the Scheme complies with the three policy aims in paragraph 5.195 of the NPSNN, within the context of Government policy on sustainable development as stated in Section 12.2.

12.3.51 The assessment sets out what mitigation measures have been incorporated into the Scheme to meet the three aims, and also any measures which were not considered reasonable or practical to include.

12.3.52 A preliminary indication of any properties likely to qualify for noise insulation under the NIR [REF 12-11] is provided in this assessment. A full assessment will be completed once the detailed design is finalised, and in accordance with the timescales set out in the NIR [REF 12-11].

Operational traffic vibration assessment

12.3.53 Vibration from traffic can be transmitted through the air or through the ground. Airborne vibration is produced by the engines and exhausts of road vehicles, with dominant frequencies typically in the range of 50 - 100Hz. Ground borne vibration is produced by the interaction of the vehicle tyres and the road surface with dominant frequencies typically in the range of 8 - 20Hz. The passage of vehicles over irregularities in the road surface can also be a source of ground borne vibration.

12.3.54 Traffic vibration can potentially affect buildings and disturb occupiers. DMRB [REF 12-14] reports that extensive research on a wide range of buildings has found no evidence of traffic induced ground borne vibration being a source of significant damage to buildings and no evidence that exposure to airborne vibration has caused even minor damage.

12.3.55 Airborne vibration is noticed by occupiers more often than ground borne vibration, DMRB [REF 12-14] states that perceptible vibration only occurs in rare cases and identifies that the normal use of a building, such as closing doors and operating domestic appliances can generate similar levels of vibration to that from traffic in most circumstances.

12.3.56 It is a requirement of new highway constructions that the highway surface be smooth and free from any discontinuities. Paragraph A5.25 of DMRB [REF 12-14] highlights that in relation to ground borne vibration "*no evidence has been found to support the theory that traffic induced vibrations are a source of significant damage to buildings".* Paragraph A5.26 of DMRB [REF 12-14] also states*: "Such vibrations are unlikely to be important when considering disturbance from new roads and an assessment will only be necessary in exceptional circumstances*". Hence, no significant effects from traffic induced ground borne vibration due to the passage of vehicles over irregularities on the Scheme, in terms of either disturbance or damage to buildings (or other structures), are anticipated, and no further assessment has been completed.

12.3.57 To assess the magnitude of the impact of traffic induced airborne vibration on residents, a parameter is needed which reflects a person's subjective rating of vibration disturbance. DMRB [REF 12-14] recommends the use of the $L_{A10,18h}$. The relationship between the $L_{A10,18h}$ and annoyance due to vibration is similar to that for annoyance due to steady state traffic noise, except that the percentage of people bothered by vibration is lower. For a given level of noise exposure, the percentage of people bothered very much or quite a lot by vibration is 10% lower than the corresponding figure for annoyance due to traffic noise. Below 58dB(A) the percentage of people bothered by traffic induced vibration is assumed to be zero.

12.3.58 The potential for vibration impacts is limited to the immediate vicinity of a road, and the relationship between annoyance due to vibration and traffic noise level in DMRB [REF 12-14] is based on properties located within 40m of a road. Therefore, at each property within 40m of all roads within the 600m calculation area, at which traffic noise levels are predicted to be 58dB $L_{A10,18h}$ or more, the percentage of people likely to be bothered very much or quite a lot by vibration has been calculated.

Reconfiguration of WGAA sports pitches assessment

12.3.59 To predict the noise from sports pitches, a 3D noise model has been prepared using the CadnaA modelling software. The DM ground model from the DMRB assessment has been used to model the existing pitch layout. The DS ground model from the DMRB [REF 12-14] assessment has been used to model the proposed layout options. As it has not been possible to undertake noise measurements when the existing sports pitches are in use, the source level of 58dB $L_{Aeq,1h}$ at 10m from the side-line halfway marking taken from the Sport England Design Guidance Note Artificial Grass Pitch (AGP) Acoustics - Planning Implications [REF 12-26] has been used.

12.3.60 Sport England has measured noise levels during nine sports sessions on three separate AGPs. The sessions included football, hockey and rugby and participation by men, women and children. The most significant noise levels were found to be generally derived from the voices of players, with the exception of hockey where impact noises of balls hitting perimeter strike boards and goal back boards were more noticeable. It is acknowledged that the reconfigured pitches would not be artificial grass, but as shown the significant noise source is from the voices of players and not the surface of the pitch.

12.3.61 At this stage the number of car parking spaces or number of cars accessing the WGAA facility is not available. Therefore, to provide an indication of the impact of noise from the use of the car park, the L_{Amax} of a door slam has been predicted at the closest parking position to the nearest NSR which is Four Winds.

12.3.62 The L_{Amax} of a car door slam has been taken from previous assessments, at a level of 78dB L_{Amax} at 2m.

12.3.63 As part of the reconfiguration of the WGAA facility, a hurling wall is proposed. To consider the noise impact of balls against the hurling wall, noise measurements of a hockey ball hitting a backboard have been used, providing a level of 94 dB L_{Amax} at 1m.

12.3.64 It is assumed that the use of the club house would remain the same as existing and that it can be used as a function room with amplified music. As no information is available regarding noise levels from the existing club house, or the final specification of the new club house, noise limits have been set based on the Institute of Acoustics Good Practice Guide on the Control of Noise from Pubs and Clubs [REF 12-27] and its associated Annex [REF 12-28], which provide guidelines regarding noise from licensed and non-licensed premises.

Assessing significance of effect

Construction

12.3.65 The main factor in identifying construction noise and vibration annoyance significant effects is the magnitude of the impact relative to the SOAEL. In general, construction noise or vibration levels above the SOAEL would be considered significant, and levels below the SOAEL not significant. However, in line with best practice this initial decision on the significance of an effect is then combined with professional judgement which takes into account a range of other factors including:

a. the duration of the impact. Based on the guidance in BS 5228 [REF 12-17; REF 12-18], construction noise or vibration levels above the SOAEL for less than 10-days (or 10-evenings/weekends or nights) in any 15, or 40-days or less (or 40 evenings/weekends or nights) in any 6-month period would not normally be considered significant. At this stage, before contractors have been appointed to construct the Scheme, detailed information on the exact timing and duration of individual activities is not known, therefore a conservative judgement has been made of the likelihood of the duration criteria being exceeded based on information provided by the Scheme buildability advisor;

b. the timing of the impact, night time impacts being more likely to be considered significant than daytime impacts;

c. the location of the impact at the receptor, for example, a receptor may contain areas which are more or less sensitive than others, for example in a school, office spaces or kitchens would be considered less sensitive than classrooms; and

d. the nature, times of use and design of the receptor, for example a receptor which is not used at night would not be considered sensitive to night time construction works.

12.3.66 The magnitude of the impact of construction traffic on public roads is assigned based on the anticipated change in traffic noise level, in accordance with the same criteria used for short term operational road traffic noise impacts, as detailed in **Table 12.6**. The significance of the effect of construction traffic is considered in the same way as operational traffic noise as detailed in the Operational Traffic section below.

Operational traffic

12.3.67 An initial identification of significant effects is carried out based on the magnitude of change in traffic noise levels due to the Scheme. DMRB [REF 12-14] provides two example classifications for the magnitude of the traffic noise impact of a road scheme, as shown in **Table 12.6**. These relate to both short term changes and long term changes in noise levels. The short term classification detailed in **Table 12.6** is the main driver of the initial identification of significant effects.

12.3.68 In general, a negligible or minor magnitude of impact for operational noise is not normally considered significant and a moderate or major magnitude of impact is normally considered significant. However, in line with best practice this initial decision on the significance of an effect is then combined with professional judgement which takes into account a range of other factors including:

a. the absolute noise levels for example if traffic noise levels are already very high (above the SOAEL) then a smaller noise level change than outlined in **Table 12.6** may be considered significant (for example 1dB in the short term). Conversely if traffic noise levels are very low (below the LOAEL) then a larger noise level change may be required to be considered significant;

b. where the magnitude of change in the short term lies relative to the boundaries between the bands outlined in **Table 12.6**, for example in some circumstances a change of 2.9dB, which just falls into the minor category, may be considered significant;

c. if the magnitude of change in the long term is different than the short term, for example if the short term change is minor (not significant) but the long term change is moderate (significant) then a significant effect may be identified;

d. the circumstances of the receptor, for example a receptor may contain areas which are more or less sensitive than others, such as office spaces or kitchens in a school, would be considered less sensitive than classrooms. Alternatively, if a receptor is particularly vulnerable, such as a school for hearing impaired children;

e. the acoustic character of an area, for example if a road scheme introduces road noise into an area where road noise is not currently a major source;

f. the likely perception of a traffic noise change (for example does the noise change combine with other changes, such as an increase in the visibility of a road), which may increase the perceived impact; and

g. the proportion of a designated site that is affected (for example comparing the proportion of a designated site within the noise study area, such as a Site of SSSI, that is above the LOAEL or SOAEL in each assessment scenario.

Reconfiguration of the WGAA facility

12.3.69 There is no specific guidance with regards to assessing the impact of noise from sports pitches; however, there are a number of relevant standards which provide some guidance and the Sport England guidance [REF 12-26] has been reviewed. This highlights the importance of considering the potential for disturbance to NSRs early in the planning and design stages.

12.3.70 The Sport England guidance note [REF 12-26] refers to the WHO Guidelines for Community Noise [REF 12-24], which recommends external daytime and evening environmental noise limits, and internal night-time limits to avoid sleep disturbance.

12.3.71 Error! Reference source not found. summarises the WHO guidelines [REF 12-24] in outdoor and indoor living areas.

Table 12.8: WHO guideline values in specific environments

Specific environment	Critical health effect(s)	Noise level
Outdoor living area	Serious annoyance, daytime and evening	55dB $L_{Aeq,16h}$ (07:00-23:00)
	Moderate annoyance, daytime and evening	50dB $L_{Aeq,16h}$ (07:00-23:00)
Inside bedrooms	Sleep disturbance, night-time	30dB $L_{Aeq,8h}$ (23:00-07:00) 45dB $L_{Amax,8h}$ (23:00-07:00)
Outside bedrooms	Sleep disturbance, night-time with window open (outdoor values)	60dB $L_{Amax,8h}$ (23:00-07:00)

12.3.72 The L_{Amax} guideline values for bedrooms are applicable to night-time periods only; no equivalent L_{Amax} guideline is proposed for the daytime. However, based on the 15dB difference between the WHO inside bedroom L_{Aeq} and L_{Amax} criteria at night a daytime and evening L_{Amax} threshold of 65 dB L_{Amax} is proposed. It has been assumed that the sports pitches and hurling wall would only be used during daytime and evening periods (07:00 to 23:00). Whereas noise from the use of the club house and car park may extend into the early hours of the night-time period (23:00 to 07:00) if events are held in the club house.

12.3.73 The Sport England guidance [REF 12-26] also refers to an alternative assessment method, where the predicted noise levels are compared to the existing noise levels. It refers to the Institute of Acoustics (IOA) and the Institute of Environmental Management and Assessment (IEMA) working consultation draft guidelines (IEMA published the updated Guidelines for Environmental Noise Impact Assessment in 2014 [REF 12-29]), which provide guidance on impact of change in noise levels. A slight impact is considered to be an increase of less than 3 dB, which conforms to the withdrawn Planning Policy Guidance 24: Planning and Noise [REF 12-4] that a change of 3 dB is the minimum perceptible under normal conditions.

12.3.74 **Table 12.9** summarises the significance of the change in noise levels. The descriptor in brackets is to be consistent with other magnitude of impact terminology in this chapter. Although it is noted that the context of the noise and surrounding area needs to be taken in to consideration.

Table 12.9: IEMA: categorising the significance of the noise change

Noise Change, dB	Impact
0	No impact
0.1 to 2.9	Slight impact (negligible)
3 to 4.9	Moderate impact (minor)
5 to 9.9	Substantial impact (moderate)
10 +	Severe impact (major)

12.3.75 The Good Practice Guide on the Control of Noise from Pubs and Clubs [REF 12-27] does not provide prescriptive criteria on the assessment of noise from licensed and non-licensed premises. However, the working-draft annex [REF 12-28] suggests criteria for entertainment noise from venues that operate more than once a week or after 23:00. These are as follows:

a. the L_{Aeq} of the entertainment noise should not exceed the representative background noise level L_{A90} (without entertainment noise); and

b. the L_{10} of the entertainment noise should not exceed the representative background noise level L_{90} (without entertainment noise) in any one third (1/3) octave band between 40 and 160Hz.

12.3.76 If the above criteria are met, entertainment noise is expected to be virtually inaudible inside any noise-sensitive properties. This equates to an effect which is not significant.

12.4 Assessment assumptions and limitations

Scheme design and limits of deviation

12.4.1 The assessment has been based on the Scheme description detailed within Chapter 3 The project, and has taken into account the lateral and/or vertical limits of deviation defined on the Works Plans [**TR010027/APP/2.3**] in order to establish a realistic worst case assessment scenario.

12.4.2 This scenario has identified and reported the effect that any lateral and/or vertical deviation would realistically give rise to. This has, for example, taken into account the potential for components of the Scheme to be positioned at a slightly higher elevation, or brought into closer proximity to receptors, and thereby potentially result in a different noise and/or vibration effect.

12.4.3 Notwithstanding any potential deviation, mitigation measures incorporated into the design of the Scheme, as described in Section 12.8, would still be deliverable within the limits of deviation and would still fulfil their intended function.

Construction

12.4.4 In order to quantify the likely noise and vibration impacts from construction works in accordance with the methods and guidance in BS 5228 [REF 12-17]; [REF 12-18], before a contractor is appointed and details of the works are finalised, it is necessary to make reasonable assumptions regarding the various activities to be undertaken and the equipment to be used, based upon the anticipated construction works programme.

Baseline noise survey

12.4.5 Short term daytime three hour monitoring was completed at one location (Location 6) on 26 March 2018, as it was not possible to gain access to a secure location to leave equipment unattended for long term monitoring.

Impact assessment and mitigation

Noise modelling

12.4.6 Traffic data used in this assessment is based on April 2018 Design Fix. Since the development of the traffic model and subsequent traffic flow data, changes have been made to the Scheme design and are published as October 2018 Design Fix. The details of the changes between April 2018 and October 2018 Design Fixes are described in Chapter 4 Scheme history and alternatives. The consequential changes in layout on forecast traffic are reported in a Technical Note contained in

the Transport Assessment Report [**TR010027/APP/7.2**]. These design changes in design fixes are not adjacent to NSRs, and any changes to traffic flows are expected to be restricted to these changed road links and the roads in the immediate vicinity of the changes. It is considered that the design changes between April 2018 October 2018 design fixes would not cause a material change in predicted changes in noise and vibrations levels, and that the conclusions of the assessment would remain valid.

12.4.7 Roads with a flow below the CRTN [REF 12-19] low flow cut of 1,000 vehicles (18hr AAWT) were excluded from the assessment of affected links and the extent of the study area, but were included in the CadnaA models. Only the road links that acted as zone connectors in the traffic model and didn't have a geographical road equivalent were removed from the noise models.

12.4.8 As detailed in Section 12.3, the proposed new road layout associated with the HS2 Birmingham Interchange Station was included in the DM and DS Future Year modelling (as this station would be operational by 2038).

12.4.9 OS Address Base data, detailing building usage, and OS building height data have generally been used as provided. However, the heights of the buildings have been standardised, and sample checks for errors (such as buildings with 0m height) have been completed using information available online and adjustments made accordingly.

12.4.10 Information on existing road surfacing has been taken from Highways England's asset database. Inaccuracies within the database may affect the outcome of the noise assessment.

12.4.11 Information and assumptions regarding the residential building heights, receivers and road surfacing corrections can be found in Appendix 12.2 [**TR010027/APP/6.3**].

12.4.12 As per guidance in DMRB [REF 12-14], in the Future Year it has been assumed that existing low noise surfaces on the M42 will have been replaced as part of the maintenance programme and a new low noise thin surfacing correction of -3.5dB has been used in the DM and DS Future Year models.

12.4.13 The potential for operational ground borne vibration impacts is related to the presence of irregularities in the road surface, which are not a significant issue with new road surfaces and are resolved by routine maintenance of existing roads. The consultation with the EHO at SMBC has not identified any local roads where there are vibration complaints. Therefore, in accordance with the guidance in DMRB [REF 12-14], operational ground borne vibration impacts are scoped out of the assessment.

Reconfiguration of the WGAA facility

12.4.14 It has not been possible to undertake noise measurements of sports activities at the WGAA facility. Noise data from Sport England guidance [REF 12-26] (see Appendix 12.4 [**TR010027/APP/6.3**]) has therefore been used to inform the applicable assessment.

12.4.15 It has been assumed that the operational hours of the club house and sports pitches are the same with and without the Scheme in place. Full details of the assessment can be found in Appendix 12.4 [**TR010027/APP/6.3**].

12.5 Study area

12.5.1 The study areas for the assessment of noise impacts of the Scheme been defined in accordance with guidance given in DMRB [REF 12-14] and which are summarised below.

12.5.2 The study area for the quantitative assessment of construction phase noise and vibration impacts focuses on the closest identified potentially sensitive receptors to various works. The receptors have been chosen based on their potential sensitivity and the proximity the construction works, including the construction compounds, soil storage areas and haulage routes. The selected receptors are also representative of neighbouring properties in their vicinity.

12.5.3 The study area for the assessment of operational phase noise impacts, as defined by DMRB [REF 12-14], includes the Scheme, the existing routes being bypassed by the Scheme, and all surrounding affected routes that are predicted to be subject to a change in noise level as a result of the Scheme of:

a. 1dB(A) or more in the short term (DM (without Scheme) vs DS (with Scheme) in the Baseline (opening) Year; or

b. 3dB or more in the long term (DM in the Baseline (opening) Year vs DS in the Future Year), subject to a minimum change of 1dB between the DM vs DS in the Future Year. The Future Year is taken as the worst affected year within 15 years after opening.

12.5.4 The roads defined as affected routes are identified by analysis of the traffic data.

12.5.5 The study area for the detailed quantitative assessment of noise impacts comprises a 600m calculation area corridor either side of the Scheme, 600m either side of the extent of the local road network to be replaced by the Scheme (i.e. the B4438 Catherine-de-Barnes Lane (Catherine-de-Barnes Lane)) and 600m either side of all affected routes within a 1km boundary of the Scheme.

12.5.6 For dwellings and other sensitive receptors that are within the 1km boundary, but more than 600m from an affected route or the Scheme, a qualitative assessment of the traffic noise impacts has been carried out.

12.5.7 For affected routes which are outside the 1km boundary, an assessment has been undertaken by estimating the CRTN BNL and the number of dwellings and other sensitive receptors within 50m of these routes.

12.5.8 The operational traffic vibration annoyance study area is defined as 40m from the edge of the Scheme carriageway.

12.5.9 For the assessment of the reconfigured WGAA facility, the potential changes in noise levels have been assessed at the nearest NSRs on Catherine-de-Barnes Lane and Shadowbrook Lane.

12.5.10 The 1km boundary and 600m calculation area are illustrated in **Figure 12.1** [**TR010027/APP/6.2**]. The identified affected routes are illustrated in **Figure 12.2** [**TR010027/APP/6.2**].

12.6 Baseline conditions

12.6.1 Long term (ten days) unattended monitoring was completed at eight locations between 15 March 2018 and 26 March 2018. Short term daytime three hour monitoring was completed at one location (Location 6) on 26 March 2018. The monitoring procedures conformed to BS 7445-1:2003 Description and Measurement of Environmental Noise [REF 12-30] and the CRTN 'shortened measurement procedure' [REF 12-19] (for the short term attended monitoring at Location 6) as appropriate.

12.6.2 The weather conditions were recorded throughout the monitoring period and the results exclude data gathered during periods of adverse weather conditions. Further details are provided in Appendix 12.3 [**TR010027/APP/6.3**].

12.6.3 The results of the baseline noise survey are also used as part of a verification exercise for the traffic noise prediction modelling. The model has been used to predict traffic noise levels at the monitoring locations, to allow comparison of the predicted and measured levels. The aim of this process is to demonstrate that the noise model is giving a sensible range of results across the study area. An exact match would not be expected for a variety of reasons, for example, the noise predictions are based on typical weekday traffic conditions over a year, not the exact traffic conditions during the sample noise monitoring period; the prediction method is designed to be conservative in terms of the effect of wind direction whereas the wind direction is likely to vary throughout the monitoring period; and the noise predictions only consider road traffic noise, whereas the measurements include all ambient noise sources.

12.6.4 The measurement locations are described in **Table 12.10**. Descriptions of the dominant and secondary noise sources have been included within **Table 12.10**. The calibration levels of the instrumentation were checked prior to and following the measurements with a field calibrator. No significant drift was noted. Full calibration details are available upon request.

Table 12.10: Monitoring locations

Location	Details	Dominant noise sources	Secondary noise sources	Measurement format
ML1	Hampton Lane Farm, Solihull Road, Hampton-in-Arden	Road traffic noise from Solihull Road and aircraft noise	Livestock	Unattended
ML2	Oak Tree Lodge, Shadowbrook Lane, Hampton-in-Arden	Road traffic noise from Catherine-de-Barnes Lane and aircraft noise	Shadow Brooke Lane, Birdsong	Unattended
ML3	Rustling Oaks, St Peters Lane, Bickenhill	Road traffic noise from A45 and M42 and aircraft noise	St Peters Lane and Birdsong	Unattended

Location	Details	Dominant noise sources	Secondary noise sources	Measurement format
ML5	Rydal, Church Lane, Bickenhill	Road traffic noise from A45 and M42 and aircraft noise	Birdsong	Unattended
ML6	Near to Park Farm Cottage, Middle Bickenhill Lane, Solihull	Road traffic noise from M42 and A45	Birdsong	Attended
ML7a	Four Winds, Catherine-de-Barnes Lane, Catherine-de-Barnes (front of property)	Road traffic noise from Catherine-de-Barnes Lane and aircraft noise	Birdsong	Unattended
ML7b	Four Winds, Catherine-de-Barnes Lane, Catherine-de-Barnes (rear of property)	Road traffic noise from Lane and aircraft noise	Birdsong	Unattended
ML8	Mayfield, Solihull Road, Hampton-in-Arden	Road traffic noise from M42 and Solihull Road and aircraft noise	Birdsong	Unattended

12.6.5 A summary of the noise monitoring results is provided in **Table 12.11**, which details the average weekday measured noise levels and a comparison with the predicted $L_{A10,18h}$ traffic noise levels using annual average weekday traffic flows.

Table 12.11: Baseline noise monitoring

Ref	Description	Measured $L_{A10,18h}$ dB free-field (weekday average over monitoring period)	Predicted traffic noise $L_{A10,18h}$ dB free-field
ML1	Hampton Lane Farm, Solihull Road, Hampton-in-Arden	59.7	60.5
ML2	Oak Tree Lodge, Shadowbrook Lane, Hampton-in-Arden	58.9	62.1
ML3	Rustling Oaks, St Peters Lane, Bickenhill	56.3	57.9
ML4	Beech Cottage, Clock Lane, Bickenhill	60.7	63.6
ML5	Rydal, Church Lane, Bickenhill	57.2	61.1
ML6	Near to Park Farm Cottage, Middle Bickenhill Lane, Solihull	56.6	59.8
ML7a	Four Winds, Catherine-de-Barnes Lane, Catherine-de-Barnes (front of property)	62.4	67.4
ML7b	Four Winds, Catherine-de-Barnes Lane, Catherine-de-Barnes (rear of property)	54.2	58.9

Ref	Description	Measured $L_{A10,18h}$ dB free-field (weekday average over monitoring period)	Predicted traffic noise $L_{A10,18h}$ dB free-field
ML8	Mayfield, Solihull Road, Hampton-in-Arden	63.4	67.9

12.6.6 As would be expected, the highest measured and predicted noise levels are recorded at locations close to an existing main road in the area such as 7a and 8. There are a number of reasons why the predicted noise levels exceed the measured noise level. Also local screening, such as private garden fences may result in lower measured noise levels, whilst such features are not included in the noise models as their acoustic performance and future maintenance is uncertain. Overall, the comparisons of measured and predicted levels provide confidence that the noise model developed to quantify the noise impacts of the Scheme is robust and suitable to inform the assessment process.

Future baseline conditions (Do Minimum)

12.6.7 A summary of overall DM traffic noise levels and the change from the Baseline (opening) Year (2023) to the Future Year (2038) is provided in **Table 12.12**.

12.6.8 **Table 12.12** is based on the façade at each building which undergoes the worst change in traffic noise level from the DM 2023 scenario to the DM 2038 scenario.

Table 12.12: Long term change in traffic noise levels (DM 2023 to DM 2038)

Change in traffic noise level		Daytime		Night-time
		Number of residential buildings	Number of other sensitive receptors	Number of residential buildings
Increase in noise level Daytime $L_{A10,18h}$ dB Night-time $L_{night,outside}$ dB	0.1-2.9	105	2	24
	3.0-4.9	0	0	0
	5.0-9.9	0	0	0
	≥10	0	0	0
No change	0	28	0	10
Decrease in noise level Daytime $L_{A10,18h}$ dB Night-time $L_{night,outside}$ dB	0.1-2.9	62	0	64
	3.0-4.9	0	0	0
	5.0-9.9	0	0	0
	≥10	0	0	0

12.6.9 The noise changes from DM2023 to DM2038 are presented as noise difference contour plots in **Figure 12.3** [**TR010027/APP/6.2**]. The maps are based on free-field traffic noise levels at first floor level (4m above ground) using a 10m x 10m grid, and are provided for illustration purposes.

12.6.10 **Table 12.13** provides a summary of the corresponding change in traffic noise annoyance at residential properties from the Scheme Baseline Year of 2023 to the Future Year of 2038, as required by DMRB [REF 12-14].

Table 12.13: Long term change in do-minimum traffic noise annoyance (DM 2023 to DM 2038)

Change in % annoyed		Daytime
		Number of residential buildings
Increase in annoyance level	<10%	69
	10 <20%	0
	20 <30%	0
	30 <40%	0
	≥40%	0
No change	0	104
Decrease in annoyance level	<10%	22
	10 <20%	0
	20 <30%	0
	30 <40%	0
	≥40%	0

12.6.11 An estimated total of 195 residential properties are located within 600m noise calculation area, as shown in **Figure 12.1** [**TR010027/APP/6.2**]. However, only 98 properties meet the DMRB [REF 12-14] criterion of 55 dB $L_{night,outside}$ at one or more facades in one or more scenarios for inclusion in the night-time traffic noise assessment.

12.6.12 A total of two non-residential potentially sensitive properties are located within the 600m noise calculation area, which are the NEC and St Peter's Church, Bickenhill.

12.6.13 54% of the residential buildings and all potentially sensitive non-residential receptors experience a negligible (0.1 - 2.9 dB) increase in daytime traffic noise levels from 2023 to 2038 in the absence of the Scheme. This is due to the general growth in traffic over time. This results in a corresponding small increase in annoyance due to traffic noise at all residential buildings. 32% of residential buildings experience a negligible (0.1 -2.9 dB) decrease and 14% of residential buildings experience no change in traffic noise levels from 2023 to 2038. This is due to the assumption that the M42 will have been resurfaced with new low noise surfacing in the future year scenario.

12.6.14 A summary of the change in annoyance due to airborne vibration from road traffic between the two DM scenarios is provided in **Table 12.14**. A total of 74 residential properties have been identified within 40m of roads in the noise prediction study area.

Table 12.14: Long term change in Do Minimum traffic vibration annoyance (DM 2023 to DM 2038)

Change in % Annoyed		Daytime
		Number of residential buildings
Increase in annoyance level	<10%	34
	10 <20%	0
	20 <30%	0
	30 <40%	0
	≥40%	0
No change	0	38
Decrease in annoyance level	<10%	2
	10 <20%	0
	20 <30%	0
	30 <40%	0
	≥40%	0

12.6.15 53% of the residential properties are expected to experience no change in vibration annoyance from 2023 to 2038 in the absence of the Scheme, and 46% are expected to experience up to 10% increase in vibration annoyance. The small increase in annoyance level is due to the normal growth of traffic over time from 2023 to 2038.

12.6.16 **Table 12.15** details the long term change in the CRTN BNL at the identified affected routes beyond the 1km study area. The location of these roads is illustrated in **Figure 12.2** [**TR010027/APP/6.2**].

Table 12.15: Affected routes beyond 1km - change in traffic noise levels (DM 2023 to DM 2038)

Link Ref.	Description	No. receptors within 50m		BNL $L_{A10,18h}$ dB at 10m from the road		
		Residential	Non-residential	2023 DM	2038 DM	Change
7500189_7500190A*	Roundabout A446, Off Chester Road, Near Birmingham Business Park	0	0	66.5	N/A	N/A
7097_7096	Bradnocks Marsh Lane, Barston Bridge	0	0	67.2	67.5	+0.3
8000554_7097	Bradnocks Marsh Lane, Barston Bridge	0	0	64.2	65.3	+1.1
2100010203_4905A	A414, Near Junction 5	1	0	69.7	67.2	-2.5
4869_7500628A	A41, B4102	8	0	70	68.9	-1.1

**this link doesn't exist in future year scenarios due to road layout changes once HS2 is operational.*

12.6.17 Two of the identified affected routes are anticipated to experience a negligible increase in traffic noise levels from 2023 to 2038 in the absence of the Scheme. However, there are no NSRs identified along these routes. For the two links where NSRs have been identified within 50m, both are anticipated to experience a negligible decrease in noise in the long term without the Scheme. At the links where there is a reduction in traffic noise levels, this is due to a change in the % HGV and/or a change in speed band between the scenarios.

12.7 Potential impacts

12.7.1 The introduction and/or modification of road infrastructure associated with the Scheme has the potential to result in changes to existing noise and vibration levels within the study area on sensitive receptors, during both the construction and operational phases in the following ways.

Construction

12.7.2 The main construction activities that would take place are site clearance, earthworks, drainage, gantry demolition and construction, retaining walls construction, bridge works and road construction (pavement) works.

12.7.3 The construction of the Scheme has the potential to result in temporary noise impacts at the closest receptors to the works. The potential for temporary construction vibration impacts is dependent on the need for construction activities which are a potentially significant source of vibration, such as piling and ground improvement works.

12.7.4 Construction traffic can have a temporary impact on sensitive receptors located along existing roads used by these vehicles. The potential for such impacts is dependent on the volume and route of construction traffic. In addition, the implementation of traffic management measures on the M42 and A45 and re-routing of existing traffic onto alternative roads during the construction works are also a potential source of temporary impacts.

Operation

12.7.5 The operation of traffic on new and modified roads within the Scheme has the potential to result in both beneficial and adverse permanent traffic noise impacts, depending on changes in traffic flows on these roads and whether these noise sources are brought in closer proximity to, or taken further away from, existing NSRs.

12.7.6 The magnitude of impact at a receptor is also dependent on a range of factors including the traffic flow, composition, speed, road surface, ground topography, the presence of intervening buildings/structures and the distance to the road.

Reconfiguration of WGAA facility

12.7.7 The reconfiguration of the sports pitches and potential relocation of the club house has the potential to change the existing noise impact from the use of the facilities at the closest identified NSRs. The Scheme also has the potential to change the existing noise levels experienced at the WGAA facility.

12.8 Design, mitigation and enhancement measures

12.8.1 The Scheme has been designed, as far as possible, to avoid and minimise impacts and effects on associated with noise and vibration through the process of design-development (see Chapter 4 Scheme history and alternatives), and by embedding measures into the design of the Scheme.

12.8.2 A number of standard measures have been identified, which would be implemented by the appointed contractor to reduce the impacts and effects that construction of the Scheme would have on NSRs.

Embedded mitigation measures

12.8.3 To mitigate construction-related effects, the proposed locations of the main site compound and associated storage areas have been identified to reduce the potential for impacts to sensitive receptors. The appointed Contractor for the Scheme will be required to develop and implement a Traffic Management Plan for the construction phase, building on the information contained in Chapter 3 The project. The Traffic Management Plan will present the haul routes and road management procedures used to manage traffic movements within the works, construction compounds and on the local road network in the vicinity of the closest NSRs.

12.8.4 To mitigate operational phase effects, the following measures have been incorporated into the design of the Scheme:

a. the mainline link road has been predominately positioned in cutting to minimise the noise impacts on the local environment; and

b. M42 Junction 5A including slip roads and the mainline link road would be constructed with a thin surface course system, with the north facing slip roads and free flow links at Junction 6 also be constructed with a thin surface course system, which results in lower levels of noise generation than a standard hot rolled asphalt surface at speeds ≥75 km/hr, to reduce noise at source (see Chapter 3 The project).

Standard mitigation measures

12.8.5 The Outline Environmental Management Plan (OEMP) [**TR010027/APP/6.11**] details the measures that would be undertaken during construction of the Scheme to mitigate temporary effects as a result in changes in noise and vibration levels.

12.8.6 The types of activities with the potential to generate noise and vibration changes during the construction phase include:

a. piling;

b. breaking of ground for road cutting;

c. concrete bursting of old structure (for example Solihull Road overbridge);

d. the compaction of materials;

e. general demolition of structures; and

f. the movement of vehicles to/around and from the site.

12.8.7 The assessment has identified that localised solid site hoarding (barriers) would likely be required to shield the following properties from construction works, due to the potential for significant adverse effects (as described in more detail in Section 12.9):

a. C3 Woodside;
b. C4 Four Winds;
c. C5 The Dale;
d. C6 Rose Cottage ;
e. C7 Farm Cottage;
f. C8 1 Clock Cottage;
g. C10 Bridge House;
h. C11 The Lodge;
i. C12 Rose Farm Cottage;
j. C14 The Bungalow; and
k. C16 Providence Cottage.

12.8.8 To provide protection, solid barriers at these locations would likely be of a minimum 2m height. Solid barriers can provide up to a 10 dB reduction in construction noise levels at ground floor rooms typically in use during the day (if it completely blocks the line of sight); however, at some locations it may not be feasible to install long term barriers due to the presence of individual accesses or the short term duration of the activity. In these locations, temporary barriers around individual plant/activities, combined with good communications with local residents, will be used where practicable.

12.8.9 The contractor will undertake assessments to demonstrate noise and vibration compliance during the construction period, the findings of which will confirm the need for, and the final height and locations of, any barriers.

12.8.10 With the implementation of best practice measures and the use of barriers, where identified, throughout the construction phase, noise impacts would be minimised at sensitive receptor locations, including those locations where construction noise levels are between the LOAEL and SOAEL.

Reconfiguration of the WGAA facility

12.8.11 Upon agreement of the final layout for the WGAA facility reconfiguration, further detailed noise assessments will be undertaken to identify if additional mitigation measures are required to reduce the potential noise impact on Four Winds.

12.8.12 Should the WGAA club house building be relocated closer to nearby NSRs, the noise limit set out in Section 12.9 would be achieved by careful design, specification and management of the new club house.

12.9 Assessment of likely significant effects

Construction noise

12.9.1 The 16 selected representative receptors at which construction noise impacts have been assessed are shown in **Table 12.16**, along with the derived SOAEL and LOAEL values. As detailed in section 12.3, to define the SOAEL and LOAEL, ambient noise levels at the relevant façade of each of the selected receptors have been determined based on predicted 2016 baseline traffic noise levels.

Table 12.16: Construction assessment representative receptors

Receptor	Address	Daytime criteria dB $L_{Aeq,12h\ (facade)}$		Evening criteria dB $L_{Aeq,4h\ (facade)}$		Night-time criteria dB $L_{Aeq,8h\ (facade)}$	
		LOAEL	SOAEL	LOAEL	SOAEL	LOAEL	SOAEL
C1	The Woodlands, Friday Lane	68	75	66	66	63	63
C2	The Paradise, Bickenhill Lane	63	70	61	65	57	57
C3	Woodside, Solihull Road	69	75	68	68	65	65
C4	Four Winds, Catherine-de-Barnes Lane	67	70	64	65	59	59
C5	The Dale, Catherine-de-Barnes Lane	66	70	63	65	59	59
C6	Rose Cottage, St Peters Lane	60	65	58	65	54	55
C7	Farm Cottage, Pitt Lane	61	65	59	65	55	55
C8	1 Clock Cottage, Clock Lane	69	75	66	66	61	61
C9	[redacted]	77	77	75	75	72	72
C10	[redacted]	66	70	64	65	59	59
C11	[redacted]	76	76	73	73	67	67
C12	[redacted]	66	70	64	65	60	60
C13	Shirley Fields, Shadowbrook Lane	66	70	65	65	63	63
C14	[redacted]	58	65	57	60	55	55
C15	[redacted]	63	70	62	65	60	60
C16	[redacted]	65	70	62	65	57	57

12.9.2 The estimated reasonable worst-case construction noise levels at the NSRs are provided in Appendix 12.1 [**TR010027/APP/6.3**] along with details of the construction activities and assumed construction plant and durations. For works such as roundabout construction and tie-ins to existing roads the distance to the works is taken as the distance to the centre of the area of works (activities 1 and 31). Therefore for some receptors the works may, at times, be closer and at times further away. For linear works to construct the new road the distance is to the centre or edge of the Scheme, as appropriate, at its closest approach. For works which are confined to a small area the distance is to the centre of the works.

12.9.3 Construction activities are shown in **Table 12.17** and are individually numbered.

12.9.4 Predicted noise levels are for the core working hours for the Scheme (weekdays 07:00 – 18:00 and Saturday 07:30 – 13:00), as described in Chapter 3 The project. As the earthworks to construct the mainline link road are likely to be of longer duration (and therefore likely to result in potentially greater effects than other proposed earthworks carried out elsewhere on the Scheme), the assessment has considered the impacts associated with potentially longer working hours for these specific works during the months of March to October (07:30 – 19:30) as a separate activity (activity 30).

12.9.5 The Junction 5A Solihull Road overbridge installation (activity 18), Solihull Road bridge demolition (activity 19), A45 non-motorised user (NMU) bridge gantry demolition (activity 20) and M42 gantry superstructure construction (activity 25) have the potential to be undertaken on a 24-hour basis as it is likely that the road would need to be closed and the works may emit significant levels of noise. Limited night-time works would also be required at Clock Interchange to tie-in existing roads; this is assessed as activity 31. Therefore, an assessment of potential night-time noise impacts from these activities has been carried out at the closest residential NSRs.

12.9.6 The SOAEL is predicted to be exceeded at a number of receptors for short-durations. The predicted noise levels represent the reasonable worst-case that would be expected during each activity. The nature of the construction phase means that the worst-case situation predicted may exist only for a matter of days, or even hours. There would be regular periods even during the course of a single day, when the assumed plant would not be in operation, for example during breaks or changes in the working routine.

12.9.7 Noise levels are estimated to be below the SOAEL at receptors C1 The Woodlands, C9 [redacted] C13 Shirley Fields and C15 [redacted] for all activities and therefore the effect at these receptors is classified as not significant.

12.9.8 At all other receptors, exceedances of the SOAEL are anticipated for certain activities. Where this is the case the reduction provided by a barrier has been incorporated into the assessment, as discussed in Section 12.8. A barrier would be unlikely to entirely block the line of sight from receptors to all plant, and the reduction is therefore taken to be 5 dB during the daytime. At night the barrier is unlikely to block the line of sight to sensitive rooms as they are likely to be at first floor level.

12.9.9 The assessment has identified that barriers are likely to be required between the following receptors and activities:

a. C3 Woodside – works to Solihull Road and in proximity on the M42 (activities 5 to 13) and Solihull Road bridge (activities 18 and 19);

b. C4 Four Winds – realignment of Catherine-de-Barnes Lane (activities 5 to 13);

c. C5 The Dale – realignment of Catherine-de-Barnes Lane (activities 5 to 13) and earthworks to create the mainline link road (activity 30);

d. C6 Rose Cottage – realignment of Catherine-de-Barnes Lane (activities 5 to 13), creation of Catherine-de-Barnes Lane northerly bridge and the retaining wall (activities 2 to 4) and earthworks to create the mainline link road (activity 30);

e. C7 Farm Cottage – realignment of Catherine-de-Barnes Lane (activities 5 to 13), earthworks to create the mainline link road (activity 30) and the demolition of the A45 NMU bridge gantry (activity 20);

f. C8 1 Clock Cottage – earthworks to create the mainline link road (activity 30);

g. C10 [redacted] – demolition of the A45 NMU bridge gantry (activity 20) and the NW free flow link bridge (activities 5 to 13, 22 and 23);

h. C11 [redacted] – works to the NW free flow link bridge (activities 5 to 13, 22 and 23);

i. C12 [redacted] – works to connect the M42 southbound and the A45 eastbound (activities 5 to 13);

j. C14 [redacted] – demolition of the A45 NMU bridge gantry (activity 20);

k. C16 [redacted] – realignment of Catherine-de-Barnes Lane (activities 5 to 13) and earthworks to create the mainline link road (activity 30).

12.9.10 The predicted construction noise levels are anticipated to exceed the SOAEL at C2 The Paradise, C4 Four Winds, C5 The Dale and C6 Rose Cottage during the demolition of Solihull Road bridge. A barrier has not been proposed as these NSRs already have no line of sight to the works.

12.9.11 Exceedances of the SOAEL are anticipated during boundary fencing at C8 1 Clock Cottage. It is apparent that the installation of an additional barrier to block the line of sight would itself result in significant effects and so on, hence a barrier for these works is not practical.

12.9.12 With this mitigation in place, the estimated reasonable worst-case construction noise levels at the NSRs are provided in **Table 12.17**. Estimated construction noise levels above the SOAEL for the relevant time period have been highlighted in red and bold. Exceedances of the LOAEL are highlighted in bold only.

Table 12.17: Estimated reasonable worst-case mitigated construction noise levels

Activity		Worst-case construction noise level L_{Aeq} dB (façade) over the working day/night (by NSR)																
		Time period	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
1	Clock Interchange - Road widening, footpath construction	Day	32	34	35	38	46	55	57	**75**	47	54	45	38	38	**53**	40	43
2	Catherine-de-Barnes Bridge (North) - Foundation excavation, piling, reinforced earthwall, In-situ concrete	Day	35	38	38	42	51	**65**	58	56	42	51	43	38	43	48	41	54
3	Catherine-de-Barnes Retaining Wall - Soil nailing and excavation	Day	37	39	36	47	**67**	**62**	52	50	36	45	37	33	40	42	37	51
4	Catherine-de-Barnes Retaining Wall - Cladding	Day	35	37	34	45	65	60	50	48	34	43	35	31	38	40	35	48
5	Earthworks*	Day	**66**	59	**77**	**73**	**80**	**77**	**62**	**72**	63	52	55	66	55	**59**	61	**78**
6	Drainage (2 gangs)*	Day	55	49	66	62	**69**	**66**	52	**61**	53	42	44	60	44	48	50	**68**
7	Boundary fencing (2 gangs)*	Day	57	50	67	56	**75**	**76**	54	**78**	54	58	65	62	46	50	52	**72**
8	Site clearance*	Day	**66**	53	**77**	**68**	**80**	**77**	61	**73**	64	66	76	**71**	55	**59**	62	**79**
9	Vehicle restraint systems*	Day	57	51	62	64	61	**62**	54	**64**	55	48	42	62	46	50	53	**70**
10	Kerbs*	Day	41	35	58	57	51	50	38	52	39	29	26	50	30	34	37	54
11	Subbase*	Day	59	52	**70**	65	62	**63**	55	**65**	56	47	43	63	48	52	55	**71**
12	Road surfacing*	Day	64	58	**76**	**71**	**68**	**69**	61	**71**	62	52	49	**69**	53	57	60	**77**
13	Lighting ducts/columns*	Day	26	29	28	31	37	49	50	**73**	41	48	39	32	42	46	49	65
14	Catherine-de-Barnes Overbridge (South) - Foundation excavation, piling, In-situ concrete**	Day	39	44	42	57	64	45	42	41	39	40	38	36	49	43	-	57
15	Catherine-de-Barnes Overbridge (South) - Beam fabrication and lifting**	Day	40	45	43	59	65	46	44	42	40	41	40	37	50	44	-	58
16	NMU bridge - Foundation excavation, piling, In-situ concrete, Beam installation**	Day	41	46	50	55	49	42	40	38	38	39	38	35	50	40	-	47

Activity		Worst-case construction noise level L_{Aeq} dB (façade) over the working day/night (by NSR)																
		Time period	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
17	Junction 5a Overbridge and Solihull Road Bridge - Foundation excavation, piling, In-situ concrete,	Day	45	43	66	49	46	38	37	36	41	36	36	34	47	38	37	42
18	Junction 5a Overbridge and Solihull Road Bridge - Beam fabrication and lifting	Day	46	45	62	51	48	40	39	38	43	38	37	36	49	40	38	44
		Night	46	45	**67**	51	48	40	39	38	43	38	37	36	49	40	38	44
19	Junction 5a - Solihull Road overbridge demolition	Day	60	58	**77**	64	61	53	52	51	56	51	50	49	60	52	49	56
		Night	60	**58**	**82**	**64**	**61**	53	52	51	56	51	50	49	60	52	49	56
20	A45 NMU bridge - Gantry demolition	Day	35	37	43	40	47	50	51	53	52	64	59	47	44	56	51	45
		Night	35	37	43	40	47	50	**56**	53	52	**69**	59	47	44	**61**	51	45
21	A45 NMU bridge - Foundation excavation, piling, In-situ concrete, beam lifting	Day	32	35	40	37	45	47	53	51	50	**66**	57	44	41	58	49	43
22	NW Free Flow Link underpass - Piling, pile caps and deck	Day	48	50	55	52	59	**61**	**65**	64	74	**75**	**85**	**69**	55	**64**	**70**	55
23	NW Free Flow Link underpass - Excavation and cladding	Day	27	29	35	31	38	39	43	42	54	56	67	49	35	43	49	34
24	M42 north and south carriageways - gantry foundation	Day	60	44	63	44	44	44	46	40	64	51	57	52	65	52	62	44
25	M42 north and south carriageways - gantry construction	Day	55	39	58	39	39	39	41	35	59	46	52	47	60	47	57	39
		Night	55	39	58	39	39	39	41	35	59	46	52	47	60	47	57	39
26	M42 north and south carriageways - Eastway retaining wall**	Day	-	-	-	-	-	-	-	-	-	-	46	48	-	40	46	-
27	M42 north of junction 6 - Hollywell Brook culvert extension**	Day	-	-	-	-	-	-	-	-	-	-	-	41	-	-	-	-
28	Site wide (Refer to temporary compound locations) - Satellite Compounds**	Day	29	30	56	43	62	52	-	-	49	63	58	50	42	-	46	52
29	Site wide (Refer to temporary compound locations) - Main Compound**	Day	-	-	-	-	-	48	60	47	-	58	48	-	-	**60**	42	40
30	Mainline Link Road earthworks**	Day	-	53	61	67	**72**	**72**	61	**74**	49	57	-	-	54	58	-	65
		Evening	-	50	59	**65**	**69**	**69**	59	**71**	47	54	-	-	51	55	-	**63**

Activity		Worst-case construction noise level L_{Aeq} dB (façade) over the working day/night (by NSR)																
		Time period	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
31	Night-time tie ins**	Night	-	-	-	-	-	-	48	55	-	44	-	-	-	44	-	-

* Noise levels calculated based on closest activity location to NSR. These works are required across the majority of the Scheme are, however, covered under the scope of other activities at specific locations. Activity locations have been assumed based upon where these works would be necessary and are not covered by other proposed activities.
** Impacts have not been calculated at certain NSRs where distance to the activity is large and impacts are likely to be negligible.

12.9.13 At receptor C2 The Paradise, night-time demolition works (activity 19) are anticipated to result in an exceedance of the SOAEL by 1dB. The predictions are of the reasonable worst-case noise levels and they only just exceed the SOAEL; hence there are anticipated to be some nights during the works where noise levels would not exceed the SOAEL. No other works are anticipated to result in noise levels that exceed the SOAEL at this NSR. The works are anticipated to last for 10-days; for the effect to be significant the construction noise level would need to exceed the SOAEL every night of the works. This is highly unlikely to occur, as such; no significant adverse noise effects at this NSR are anticipated.

12.9.14 C3 Woodside is the closest identified NSR to the works at M42 Junction 5A and the realignment of B4102 Solihull Road (Solihull Road) (activities 5 to 13 and 17 to 19). This is also representative of the neighbouring property Mayfield. Exceedances of the daytime SOAEL by 2dB are estimated during site clearance (activity 8); however, this activity would only last for 15 days and hence the exceedance is unlikely to occur for ten or more days in 15, or more than 40 days in six months; hence a significant effect is not anticipated. The realignment of Solihull Road (activities 12 and 19) is anticipated to result in exceedances of the daytime SOAEL by 1 or 2dB and would last for 100 days. There is a risk of levels above the SOAEL occurring for 10 or more days in 15, or more than 40 days in six months; therefore the daytime adverse construction noise effect is classed as significant at these NSRs. The night-time SOAEL is anticipated to be exceeded by 2dB during installation of the Junction 5A overbridge and Solihull Road overbridge (activity 18). The beam installation is anticipated to last five days (J5A overbridge) and ten days (Solihull Road) and these works would be separated by a period of around ten months. The small predicted exceedance and short duration of these works means these activities are unlikely to result in significant effects. The demolition of Solihull Road overbridge (activity 19) is anticipated to exceed the night-time SOAEL by 17dB. The bridge demolition would last 10 days and the construction noise levels are considered likely to exceed the night-time SOAEL throughout. As such this activity would generate a night time noise effect considered significant at C3 Woodside.

12.9.15 At C4 Four Winds, exceedances of the daytime SOAEL are anticipated during earthworks (activity 5, exceedance of 3dB) and surfacing works (activity 12, exceedance of 1dB). These activities are associated with the works to realign Catherine-de-Barnes Lane, which would take approximately 60 days, followed by a break of approximately 10 months, and then for another 100 days approximately. Depending on the specific activity, exceedances of the SOAEL are anticipated when the average distance to all plant associated with the activity is no more than 130m to 155m from the NSR. The works are linear in nature and would extend over approximately 1.4km of road, hence for large periods of time the NSR would be further than 155m from C4.

12.9.16 On that basis the risk of levels above the SOAEL occurring for ten or more days in 15, or more than 40 days in six months, is reduced and no significant adverse daytime construction noise effect has been identified. The night-time SOAEL is anticipated to be exceeded by 5dB during demolition of Solihull Road overbridge (activity 19). The construction noise levels are considered likely to exceed the night-time SOAEL for the duration of these works. As such a significant night-time construction noise effect has been identified.

12.9.17 At C5 The Dale, exceedances of the daytime SOAEL of 5dB to 10dB are anticipated during the works to realign Catherine-de-Barnes Lane (activities 5 (earthworks), 7 (boundary fencing) and 8 (site clearance)). Each of these activities is likely to be of relatively short duration hence, as with C4, exceedances of the SOAEL are not anticipated to occur for the required durations and therefore no significant effect has been identified. Exceedances are also anticipated during the daytime (2dB) and evening (4dB) during the earthworks to create the mainline link road (activity 30). These works would last for around seven months and would be performed simultaneously on three sections of the road. There is a risk of exceedances of the daytime and evening SOAELs for longer than the required durations; therefore a significant adverse construction noise effect has been identified at this receptor during the daytime and evening. During the night a 2dB exceedance of the SOAEL is anticipated due to the demolition of Solihull Road overbridge (activity 19); however, given the small exceedance and short duration of these works a significant effect is not anticipated.

12.9.18 C6 Rose Cottage is representative of an additional five residential properties to the south of St Peter's Lane in close proximity. Activities 5 to 8 and 12, all associated with the realignment of Catherine-de-Barnes Lane, result in exceedances of the SOAEL by between 1 and 12dB. There is a risk that the exceedances of the SOAEL would occur for ten or more days in any 15, or more than 40 days in any six months. As such a significant adverse construction noise effect has been identified. Activity 30 (earthworks to create the mainline link road) is anticipated to result in exceedances of the daytime and evening SOAELs by 7dB and 4dB respectively and are therefore likely to result in a significant adverse effect.

12.9.19 At C7 Farm Cottage, the night-time A45 NMU bridge gantry demolition (activity 20) is anticipated to result in an exceedance of the night-time SOAEL of 1dB. This activity is anticipated to last for five days; due to the very short duration no significant adverse night-time construction noise effect has been identified.

12.9.20 C8 1 Clock Cottage is also representative of the additional nine properties to the south on the west side of Clock Lane. Boundary fencing works (activity 7) are anticipated to result in an exceedance of the SOAEL at this receptor by 3dB. The duration of the works close to this NSR would be very short and hence significant adverse effects are not anticipated. During the earthworks to create the mainline link road (activity 30) an exceedance of the evening SOAEL by 5dB is also anticipated. Exceedances of the SOAEL are anticipated whilst the works are within 165m of the receptor during the evening. The works may be within this distance for 10 or more days in any 15, or more than 40 days in six months; as a result a significant adverse evening construction noise effect has been identified.

12.9.21 The piling, pile capping and decking of the north west free flow link underpass (activity 22) is anticipated to result in exceedances of the daytime SOAEL by 5dB at C10 [redacted] and 9dB at C11 [redacted] These impacts are also anticipated at the other residential property to the south of C11 on Wyckhams Close. There is a risk of levels above the SOAEL occurring for longer than the required durations and therefore the adverse construction noise effect is classed as significant at these NSRs. A 10dB exceedance of the night-time SOAEL is anticipated at C10 during the A45 NMU bridge gantry demolition (activity 20). Due to the short duration of these works a significant effect has not been identified.

12.9.22 At C12 [redacted] the SOAEL is anticipated to be exceeded by 1dB due to site clearance (activity 8) associated with the connection of the M42 southbound to the A45 eastbound. Site clearance at this location would last for five days, hence a significant construction noise effect is not identified.

12.9.23 At C14 [redacted] the only works anticipated to result in an exceedance of the SOAEL is the night-time A45 gantry demolition (activity 20, exceedance of 6dB). Due to the short duration of this activity a significant adverse construction effect is not anticipated.

12.9.24 At C16 [redacted] exceedances of the SOAEL of 1dB to 9dB are anticipated during activities 5, 7, 8, 11 and 12 whilst Catherine-de-Barnes Lane is being realigned. There is a risk that the exceedances of the SOAEL would occur for ten or more days in any 15, or more than 40 days in any six months, as such a significant adverse construction effect has been identified. Earthworks to create the mainline link road (activity 30) are anticipated to result in an exceedance of the evening SOAEL by 3dB. The duration of works within this distance is anticipated to be relatively short. Hence the risk of levels above the evening SOAEL occurring for longer than the required durations is reduced and a significant adverse construction noise effect has not been identified.

12.9.25 Given the distance to the nearest construction works, it is predicted that the construction activities would not have a significant adverse effect on the users of the Grand Union Canal.

Construction vibration

12.9.26 The majority of the proposed piling would be performed using the rotary bored method, which does not generate significant levels of vibration. Impact piling is anticipated to be required for the installation of the sheet pile walls for the permanent and temporary works at the NEC underpass (activity 22). The only impact piling work within 100m of a receptor (C10) is the construction of the south-east retaining wall. The impact piling predictions have assumed all piles would be driven to refusal and the blow energy source data have been taken from typical values in BS 5228 [REF 12-18]. Further details on the assumed source data are provided in Appendix 12.1 [**TR010027/APP/6.3**].

12.9.27 Predicted maximum ppv levels for receptors within 100m of impact piling, ground compaction and/or pavement works are shown in **Table 12.18**.

Table 12.18: Predicted maximum ppv levels from piling and ground compaction works for receptors within 100m

Receptor	Maximum ppv mms^{-1}		
	Impact Piling	Ground compaction / pavement works – steady state operation	Ground compaction / pavement works – start up + rundown
C3 – Woodside, Solihull Road	-	0.89	0.53
C4 – Four Winds, Catherine-de-Barnes Lane	-	0.47	0.53
C5 – The Dale, Catherine-de-Barnes Lane	-	0.89	0.53
C6 – Rose Cottage, St Peters Lane	-	0.89	0.53
[redacted]	-	0.89	0.53
C10 – [redacted]	4.0	0.13	0.25
C11 – [redacted]	-	0.45	0.53
C12 – [redacted]	-	0.14	0.26
C16 – [redacted]	-	0.89	0.53

12.9.28 For human receptors for continuous vibration (i.e. compaction works) the LOAEL is defined as a ppv of 0.3mms^{-1}, this being the point at which construction vibration is likely to become perceptible. The SOAEL is defined as a ppv of 1.0mms^{-1}, this being the level at which construction vibration can be tolerated with prior warning.

12.9.29 The SOAEL is not exceeded at any receptors during start-up and run-down of compaction plant, assuming a minimum 50m separation distance is used. Similarly the SOAEL is not exceeded at any receptors during steady-state operation of compaction plant, assuming vibratory rollers are not used within 25m of a property. The predicted maximum ppv is between the LOAEL and SOAEL at seven of the identified receptors. No significant adverse construction vibration effects are anticipated due to the compaction plant.

12.9.30 The predicted maximum ppv exceeds the SOAEL at C10 when the proposed sheet piling is performed at the closest approach (75m). These works are anticipated to take 33 days, with the distance varying between a minimum of 75m and 195m. The prediction method in BS 5228 [REF 12-18] is only applicable to distances up to 111m from the source to the receptor and at this distance the SOAEL is still exceeded. Therefore the potential levels at the receptor have been considered further by examining the historic case study data in BS 5228 [REF 12-18]. There are seven reported measurements of vibration levels generated by sheet steel piling at distances in excess of 75m and these are shown below in **Table 12.19**.

Table 12.19: BS 5228-2:2009 relevant historic data on vibration from driven sheet steel piling

Soil conditions	Theoretical energy per blow (kJ)	Distance (m)	ppv (mm/s)
Fill/6 m alluvium/4 m to 6 m peat, clay, sand and silt/1.3 m sand and gravel/5 m stiff clay/9 m dense sand/hard chalk	71.6 to 143.2	130	0.1
		250	0.015 to 0.025
Not recorded	Not recorded	300	0.015

12.9.31 The actual energies per blow may exceed those in **Table 12.19**, and piles may have not been driven to refusal. Nevertheless, given that the limit of $1mms^{-1}$ (SOAEL) is 10-times the highest of the measured levels, it is considered highly likely that the actual levels would be below this. On this basis the risk of levels exceeding the SOAEL for ten or more days in 15 or more than 40 days in six months is reduced, as such no significant adverse effect has been identified.

12.9.32 The potential for combined effects from noise and vibration during construction works resulting in additional significant effects has been considered. No significant adverse effects are predicted for both construction noise and vibration at individual receptors. With the implementation of standard mitigation measures, receptors C3, C4, C5, C6, C8, C10, C11 and C16 are all predicted to experience construction noise levels above the SOAEL, and also experience vibration levels between the LOAEL and SOAEL for compaction works at the closest approach of vibratory rollers. However, based on the short duration of the likely vibration impacts no significant combined effect is anticipated.

Construction traffic noise

12.9.33 During the construction phase there would be additional vehicle movements from staff and delivery HGVs accessing the site from the surrounding road network. These vehicles have the potential to increase noise levels at nearby NSRs. The routes these vehicles would take will be included within the OEMP [**TR0100027/APP/6.11**] and would likely be restricted to the major roads in the vicinity of the Scheme, thus minimising the potential for short term significant adverse effects at receptors.

12.9.34 Peak construction would occur in 2021, the vehicle movements are spread across different Scheme areas, with the highest number of vehicles accessing the main compound at Clock Interchange. Based on the peak construction traffic in 2021, the BNL has been calculated for each road link in the construction traffic model both ‘with’ and ‘without’ the construction traffic. Based on the 18 hour AAWT flows, the additional construction traffic would result in a predicted increase in noise levels of up to 0.5dB, which is a negligible increase. As a worst case assessment the traffic flows in the AM peak and PM peak periods have also been assessed as this is when the highest number of construction vehicle movements occur. In the AM peak period, three road links around Clock Interchange are predicted to have an increase in noise levels of between 1.1dB and 2.4dB. During the PM peak period only one link road at Clock Interchange is predicted to have

an increase in noise levels of 1.1dB. The increases during the AM and PM peak periods are classed as minor. All other roads in the construction traffic model are predicted to less than 1dB increase in the peak periods. Therefore, the construction traffic for the Scheme is not likely to result in significant adverse effects.

12.9.35 The Scheme would involve a number of works on the M42 and A45, during which there are likely to be changes in traffic noise levels due to speed restrictions, lane and slip road closures and vehicle re-routing. The extent of the required traffic management would be developed by the construction Contractor and would be captured in the construction stage Traffic Management Plan.

12.9.36 Based on the available construction traffic data, the assessment has concluded that the construction traffic noise impacts are not considered likely to generate significant adverse noise effects at the nearest NRSs. As such, no further construction traffic noise mitigation is currently required.

Operational traffic noise

12.9.37 All noise difference contour plots (see **Figure 12.4** and **12.5** [**TR010027/APP/6.2**]) are based on free-field traffic noise levels at the first floor level (4m above ground) using a 10m x 10m grid and are provided for illustration purposes.

Operational traffic noise – Baseline (Opening) Year 2023

12.9.38 **Table 12.20** summarises the short term change in traffic noise levels in 2023 between the DM and DS scenarios at both residential and other sensitive receptors within the 600m calculation area.

Table 12.20: Short term change in traffic noise levels (DM 2023 to DS 2023)

Change in noise Level		Daytime	
		Number of dwellings	Number of other sensitive receptors
Increase in noise level Daytime $L_{A10,18h}$ dB	0.1-0.9	38	2
	1.0-2.9	3	0
	3.0-4.9	0	0
	≥5	0	0
No Change	0	42	0
Decrease in noise level Daytime $L_{A10,18h}$ dB	0.1-0.9	112	0
	1.0-2.9	0	0
	3.0-4.9	0	0
	≥5	0	0

12.9.39 The noise level difference contours (DS 2023 minus DM 2023) are presented in **Figure 12.4** [**TR010027/APP/6.2**].

12.9.40 An estimated total of 195 residential buildings are located within the 600m noise calculation area. There are two non-residential sensitive buildings located within the 600m calculation area. These are the NEC and St Peter's Church, Bickenhill.

12.9.41 In the opening year of 2023, three residential properties are anticipated to experience a minor adverse impact due to the Scheme, these being Oak Tree Lodge on Shadowbrook Lane, The Barn on St Peters Lane and Orchard Cottage on St Peters Lane.

12.9.42 The remaining residential properties are predicted to experience either negligible (adverse or beneficial) impacts or no change due to the Scheme.

12.9.43 The two non-residential receptors are predicted to experience a negligible adverse impact due to the Scheme. A section of the Grand Union canal would be situated within the study area. In the short term there is a negligible decrease in noise levels in this area, which is classed as not significant.

12.9.44 Overall in the short term, the Scheme is likely to result in negligible to minor increase in traffic noise levels at 41 residential properties and two non-residential receptors, negligible decreases in traffic noise levels at 112 residential properties and no change in noise levels at 42 properties. These effects are not classed as significant.

12.9.45 As shown on **Figure 12.4** [**TR010027/APP/6.2**] the increases in traffic noise levels are due to the traffic using the mainline link road. As result of the Scheme there is decrease in traffic flows along the M42 between the new J5a and J6.

Operational traffic noise - Future Year 2038

12.9.46 **Table 12.21** summarises the long term change in traffic noise levels between the 2023 DM and 2038 DS scenarios at both residential properties and other sensitive receptors within the 600m calculation area.

Table 12.21: Long term change in predicted do-something traffic noise levels (DM 2023 to DS 2038)

Change in noise Level		Daytime		Night-time
		Number of dwellings	Number of other sensitive receptors	Number of dwellings
Increase in noise level Daytime $L_{A10,18h}$ dB Night-time $L_{night,outside}$ dB	0.1-2.9	133	2	18
	3.0-4.9	0	0	0
	5.0-9.9	0	0	0
	≥10	0	0	0
No Change	0	27	0	14
Decrease in noise level Daytime $L_{A10,18h}$ dB Night-time $L_{night,outside}$ dB	0.1-2.9	35	0	66
	3.0-4.9	0	0	0
	5.0-9.9	0	0	0
	≥10	0	0	0

12.9.47 The long term noise level difference contours (2038 DS minus 2023 DM) are presented in **Figure 12.5** [**TR010027/APP/6.2**].

12.9.48 In the long term (2023 DM to 2038 DS) the majority of the residential receptors (68%) are anticipated to experience a negligible adverse impact as a result of changes in daytime road traffic noise levels due to the Scheme and the general increase in traffic noise levels over time. The remaining residential properties are predicted to experience either negligible beneficial impacts during the daytime or no change due to the Scheme.

12.9.49 The two non-residential receptors are predicted to experience a negligible adverse impact due to the Scheme. A section of the Grand Union canal near Catherine-de-Barnes falls within the 600m calculation area. In the long term there is a negligible increase in noise levels in this area, which is classed as not significant.

12.9.50 98 residential receptors meet the criteria for consideration in the night-time traffic noise assessment. Negligible beneficial impacts due to the Scheme are predicted to occur for the majority of the NSRs at night due to the Scheme, with 14 predicted to experience no change and 18 a negligible adverse impact.

12.9.51 These effects of the Scheme in the long term are considered to be not significant.

12.9.52 As shown on **Figure 12.5** [**TR010027/APP/6.2**] the increase in traffic noise levels are due to the traffic using the mainline link road. As a result of the Scheme there would a predicted decrease in traffic flows along the M42 between the new Junction 5A and Junction 6. In the Future Year there are also increases in road traffic noise levels around the new road layout due to HS2 and the general trend for traffic noise levels to increase over time.

12.9.53 **Table 12.22** outlines the predicted worst case change in annoyance due the Scheme. The six properties identified as experiencing the greatest change in annoyance are properties on St Peter's Lane (Orchard Cottage, The Barn, Ivy Cottage and Rose Cottage), and Oak Tree Lodge, Shadowbrook Lane and Haystowe, Church Lane, which are predicted to experience a negligible increase in traffic noise in the long term.

Table 12.22: Worst case change in traffic noise annoyance

Change in annoyance level		Do-something
		Number of dwellings
Increase in annoyance level	<10%	49
	10<20%	35
	20<30%	6
	30<40%	0
	≥40%	0
No change	0	93
Decrease in annoyance level	<10%	12
	10<20%	0
	20<30%	0
	30<40%	0
	≥40%	0

Operational traffic noise - NSRs within 1km

12.9.54 Based on the contour plots in **Figures 12.4** and **12.5** [**TR010027/APP/6.2**] all NSRs within the 1km boundary but outside the 600m calculation area are likely to be subject to either; a negligible adverse impact, no change or a negligible beneficial impact, which are all considered not significant effects as a result of the Scheme in the short and long term.

Operational traffic noise - above SOAEL

12.9.55 **Table 12.23** details the number of residential buildings in the 600m calculation area which would have one or more facades above the daytime or night-time SOAEL for the four assessment scenarios.

12.9.56 The Scheme would result in an overall reduction in the number of residential buildings with one or more façade experiencing traffic noise levels above the SOAEL. No residential building in the vicinity of the Scheme, which experiences noise levels above the SOAEL, experiences an increase of 1dB or more in the short term.

Table 12.23: Number of Residential Buildings above the SOAEL

Scenario	Day	Night
2023 DM	44	112
2023 DS	36	95
2038 DM	44	94
2038 DS	40	89

12.9.57 The majority of residential buildings which remain above the SOAEL are in close proximity to main roads and experience only a negligible change in traffic noise levels due to the Scheme.

Operational traffic noise - noise insulation regulations

12.9.58 A preliminary consideration has identified one property as potentially qualifying for noise insulation works under the NIR [REF 12-11].

12.9.59 A complete assessment will be completed in accordance with the timescales set out in the NIR [REF 12-11]. The magnitude of the change in traffic noise levels at this property is negligible in both the short and long term.

Operational traffic noise - designated sites

12.9.60 Bickenhill Meadows SSSI is split into two units, one unit (Shadowbrook Meadows) is located to the north of Shadowbrook Lane and to the east of the Scheme, while the second unit (Castle Hill Meadow) is located to the west of the Scheme. The River Blythe SSSI is located approximately 400m to the south of the Scheme. Both these SSSIs are located within the 600m traffic noise calculation area.

12.9.61 **Table 12.24** and **Table 12.25** detail the percentage of the area of the designated sites within the nose modelling area which falls below the daytime LOAEL, between the LOAEL and the SOAEL and above the SOAEL, as defined in **Table 12.7**, with regards to impacts on human receptors.

Table 12.24: Percentage of area of the Bickenhill Meadows SSSI with the 600m calculation area

Daytime traffic noise levels $L_{Aeq,16h}$ dB (free-field)	Scenario % of area			
	2023 DM	2038 DM	2023 DS	2038DS
Below LOAEL (50 dB)	0	0	0	0
Between LOAEL and SOAEL (50 to 63 dB)	100	100	100	100
Above SOAEL (63 dB)	0	0	0	0

Table 12.25: Percentage of area of the River Blythe SSSI with the 600m calculation area

Daytime traffic noise levels $L_{Aeq,16h}$ dB (free-field)	Scenario % of area			
	2023 DM	2038 DM	2023 DS	2038DS
Below LOAEL (50 dB)	0	0	0	0
Between LOAEL and SOAEL (50 to 63 dB)	42	37	42	36
Above SOAEL (63 dB)	58	63	58	64

12.9.62 Bickenhill Meadows SSSI noise levels with and without the Scheme are between the LOAEL and SOAEL. Bickenhill Meadows SSSI is a grasslands site and does not have any noise sensitive species, as confirmed by the biodiversity assessment (see Chapter 9 Biodiversity). At Blythe River SSSI virtually no change in the area above the SOAEL and between the LOAEL and SOAEL is anticipated due to the Scheme.

Operational traffic vibration

12.9.63 A summary of the long term change in annoyance due to airborne vibration from road traffic due the Scheme is provided in **Table 12.26**. A total of 74 residential properties have been identified within 40m of the Scheme and the identified affected routes within the 1km boundary.

Table 12.26: Worst case change in traffic airborne vibration annoyance

Change in annoyance level		Daytime
		Number of residential properties
Increase in annoyance level	<10%	43
	10<20%	4
	20<30%	0
	30<40%	0
	≥40%	0
No change	0	22
Decrease in annoyance level	<10%	4
	10<20%	1
	20<30%	0
	30<40%	0
	≥40%	0

12.9.64 58% of the residential properties are expected to experience up to 10% increase in vibration annoyance, with four properties (on Bickenhill Lane) expected to experience an increase of between 10 to 20% in vibration annoyance. Twenty two properties are expected to experience no change, four properties expected a small decrease in vibration annoyance and one property is expected to experience a decrease of between 10 and 20% in vibration annoyance. The resulting effect of the Scheme on operational airborne vibration impacts is classed as not significant.

Operational – traffic noise-affected routes

12.9.65 **Table 12.27** details the short term (ST) and long term (LT) change in the BNL at the identified affected routes beyond the 1km boundary due to the Scheme. The location of these roads is illustrated in **Figure 12.2** [**TR010027/APP/6.2**].

Table 12.27: Affected routes beyond 1km - Change in traffic noise levels

Link Ref.	Description	No. receptors within 50m		BNL L_{A10},18h dB at 10m from the affected route			
		Residential	Non-residential	2023 DS	2038DS	ST Change	LT Change
7500189_7500190A*	Roundabout A446, Off Chester Road, Near Birmingham Business Park	0	0	65.5	N/A	-1.0	N/A
7097_7096	Bradnocks Marsh Lane, Barston Bridge	0	0	64.4	67.3	-2.8	+0.1
8000554_7097	Bradnocks Marsh Lane, Barston Bridge	0	0	62.9	65.4	-1.3	+1.2
2100010203_4905A	A414, Near Junction 5	1	0	68.6	67.3	-1.1	-2.4
4869_7500628A	A41, B4102	8	0	69	69.2	-1.0	-0.8

**this link doesn't exist in future year scenarios due to road layout changes once HS2 is operational.*

Summary of operational traffic noise environmental effects

12.9.66 The affected routes beyond the 1km boundary are anticipated to experience a decrease in traffic noise levels in the short term. In the long term two links are anticipated to experience a negligible increase in traffic noise levels, however there are no NSRs within 50m of these roads and the majority of the increase is due to the growth in traffic from 2023 to 2038 as illustrated in **Table 12.15**. The links where there is a reduction in traffic noise levels is due to change in % HGVs and change in speed bands between the scenarios.

A summary of the operational traffic environmental effects, including a summary of the justification for the significance conclusion, is provided in **Table 12-28**.

Table 12-28: Summary of operational traffic noise environmental effects

Receptor	Magnitude of impact in short term	Significance	Justification
3 properties: Oak Tree Lodge on Shadow Brook Lane and The Barn and Orchard Cottage, both on St Peters Lane	Minor increase	Not Significant	Minor increase in road traffic noise, and are below SOAEL
38 properties on Church Lane, St Peters Lane, Middle Bickenhill Lane, Friday Lane, Solihull Road, Diddington Lane, Bickenhill Lane, NEC and one place of worship	Negligible increase	Not significant	Magnitude of change not significant. No increase in number of properties exceeding SOAEL
112 properties including the following 8 properties which noise levels reduce below SOAEL. The Dale and Four Winds on Catherine-de-Barnes Lane; 117, Old station Road; Providence Cottage, St Peters Lane; Wyckhams Close; Shirley Fields, Shadowbrook Lane; 3 Clock Cottage, Clock Lane; and Springfields, Friday Lane;	Negligible decrease	Not significant	Levels reduced below SOAEL for 8 properties. Magnitude of change not significant
42 properties which are located on St Peters Lane, Clock Lane, Bickenhill Lane, Friday Lane, Soilhull Road, Church Lane, Old Station Road and Coventry Road	No change	Not significant	Magnitude of change not significant
Grand Union Canal	Negligible decrease	Not significant	Magnitude of change not significant. Also users of the canal are likely to be transient
GAA sports pitches - existing pitch (which is to remain)	Negligible to moderate increase	Not significant	Only a very small proportion of the proposed pitches are expected to experience a moderate increase in noise. Due to the nature of the use of the site a significant noise contribution from players and spectators would be expected, therefore the increase in road traffic noise will not affect how the pitches are used.

12.9.67 The assessment has concluded that the operational traffic noise and vibration impacts predicted are not considered to generate significant adverse noise effects at receptors. As such, no further operational noise mitigation is required.

Operational – effect on NSRs from reconfiguration of the WGAA facility

12.9.68 At the time of the assessment, the final reconfiguration location of the WGAA facility has not been identified due to on-going consultation with affected parties.

12.9.69 In light of this, and to progress the noise assessment, an exercise has been undertaken to appraise the five current southern reconfiguration options on the nearest NSRs to identify the 'worst case' option in terms of potential noise impacts, see Appendix 12.4 [**TR010027/APP/6.3**].

12.9.70 In summary the worst case reconfiguration option for the WGAA facility identified through this process is Option 3. This option has been presented within the noise assessment, and the five options for the WGAA reconfiguration are presented on **Figure 3.5a** to **3.5e** [**TR010027/APP/6.2**].

12.9.71 The nearest NSR, 'Four Winds', is to the south of the reconfiguration site. In addition, the potential for noise impacts have also been considered at Solihull Music School to the south west and properties on Catherine-de-Barnes Lane and Shadowbrook Lane to the east/south-east.

12.9.72 It is assumed that the use of the club house would continue as a venue that holds functions with plays amplified music. However, no information is available regarding noise levels from the existing club house and the proposed specification of the new building is not known. As such, a noise limit for the new club house has been set based on IOA guidance [REF 12-27; REF 12-28].

12.9.73 Based on baseline survey data, as detailed in Section 12.5 and Appendix 12.4 [**TR010027/APP/6.3**], the night-time representative background noise level has been determined at the rear of Four Winds (ML7b), the closest NSR to proposed new club house as a worst case scenario, as the function rooms of the club house could potentially be in use after 11pm, as detailed in Appendix 12.4 [**TR010027/APP/6.3**]. Therefore, the specification of the new club house will be designed to be meet the following limits:

a. the L_{Aeq} of the entertainment noise should not exceed the representative background noise level L_{A90} of 40dB (without entertainment noise); and

b. the L_{10} of the entertainment noise should not exceed the representative background noise level L_{A90} of 40dB (without entertainment noise) in any one third (1/3) octave band between 40 and 160Hz.

12.9.74 To assess the potential noise impact due to the uses of the sports pitches, the average (L_{Aeq}) noise from the pitches have been predicted for the existing layout and for the 5 options.

12.9.75 **Table 12.29** shows the predicted sports pitch noise levels at the nearby NSRs for the worst case Option 3.

Table 12.29: Predicted noise levels from the use of sports pitches

NSR	Predicted $L_{Aeq,1hr,}$ dB	
	Existing layout	Option 3
Four Winds	46.6	49.6
Music School	34.1	34.9
The Dale, Catherine-de-Barnes Lane	51.8	47.9
Oak Tree Lodge, Shadowbrook Lane	47.3	45.9
Meadow View, Shadowbrook Lane	45.0	43.7
The Paddocks, Shadowbrook Lane	44.6	43.8
Green Acre, Shadowbrook Lane	44.4	42.6
The Pleck, Shadowbrook Lane	43.5	42.4

12.9.76 The predicted noise levels at the nearest NSRs from the use of the Option 3 sports pitches are below the daytime WHO guidelines [REF 12-24] level lower criterion of 50 dB L_{Aeq}. However, the reconfigured sports pitches would be predicted to result in an increase compared to the existing layout at Four Winds and Solihull Music School. Option 3 would result in a 3dB increase in sports noise at Four Winds which is classed as a moderate increase. At the music school, Option 3 would result in a 0.8 dB increase in sports noise, which is classed as a negligible impact. For the other properties assessed, there is a reduction in sports noise compared to the existing scenario. For the purpose of the assessment, it has been assumed that the sports pitches would not be used during the night-time period as the existing facility does not benefit from flood lighting.

12.9.77 The change in predicted sports pitch noise must also be considered in the context of the existing baseline ambient noise levels. The predicted sports pitch noise levels are lower than the existing ambient noise levels for the properties on Catherine-de-Barnes Lane and Shadowbrook Lane. The existing ambient noise levels at the rear of Four Winds are as expected, lower than the noise levels at the front of the property which is adjacent to Catherine-de-Barnes Lane. The predicted sports pitch noise levels are generally lower or similar to the existing ambient noise levels at the rear of Four Winds.

12.9.78 As part of the reconfigured site, a hurling wall is proposed. Although it has been assumed that the hurling wall would not be used during the night-time period the L_{Amax} noise levels have been considered due to the impact nature of the sound of a ball hitting the hurling wall.

12.9.79 The predicted L_{Amax} noise levels for all options are significantly below the daytime L_{Amax} criteria of 65dB and therefore the use of the hurling wall is unlikely to have an adverse impact on the nearby NSRs.

12.9.80 With regards to car parking noise, the L_{Amax} of a single door slam has been predicted at Four Winds, assuming the car is parked in the nearest space to the NSR. It has been assumed that the car park is used during both the daytime and night-time periods. For Option 3, the predicted L_{Amax} levels are significantly higher than the existing scenario. But all predicted levels are below the night time L_{Amax} WHO guideline [REF 12-24] value of 60dB.

12.9.81 Taking into consideration the change in noise levels from the sports pitches, the potential noise from the use of the new hurling wall, club house and car parking, it is considered that Option 3 would be the worst case in terms of potential adverse impact on the nearest NSR Four Winds.

12.9.82 Operational – effects of the Scheme on the WGAA facility

12.9.83 The change in traffic noise levels at the reconfigured WGAA facility as a result of the Scheme have also be considered due to the potential impact on users of the site.

12.9.84 The opening year noise contours (see **Figure 12.4** [**TR010027/APP/6.2**]) shows as expected an increase in traffic noise levels adjacent to the new road. To the north and east of the WGAA facility, the noise levels are predicted to increase by up to 2.9dB in the Baseline (Opening) Year of the new road. To the west of the WGAA facility the noise levels are predicted to increase by less than 1dB. To the south and south west of the WGAA facility there is an increase of less than 1dB in noise levels, and to the south east there is a less than 1dB decrease in noise levels. Based on the DMRB classification of noise impacts, a change in noise levels in the short term, of less than 1dB is negligible and between 1dB and 2.9dB is minor.

12.9.85 A small portion (north east corner) of the existing pitch which is to remain within Option 3 would experience an increase up to 4.9dB which is a moderate adverse impact. The north and eastern section of the existing pitch would experience an increase in noise levels of up to 2.9dB (minor adverse impact), and the remaining of the pitch, less than 1dB increase (negligible adverse impact).

12.9.86 For the pitch that would remain in its current orientation within Option 3, there may be some impact on the players or spectators in the north east corner of the pitch, for example the ability to hear instructions or other players may be reduced. However, this affects a small section of the pitch and the assessment has not taken into consideration any additional fencing/screening which may be required for the site.

12.9.87 Given the uncertainty at present of the absolute reconfiguration of the WGAA, a further assessment of the noise impacts from the Scheme on the WGAA, and of the WGAA reconfiguration on nearby NSRs, will be undertaken once the final layout has been confirmed.

12.9.88 The assessment has concluded that the reconfiguration of the WGAA as presented in this chapter as the worst case is not considered to generate significant adverse noise effects at the nearest identified NRSs. As such no further mitigation beyond that already considered in the assessment is currently required. It is also noted that depending upon the final layout, it may be possible to design the reconfigured layout so that the noise levels are lower than those set out in the worst case assessment.

Compliance with policy

12.9.89 The key policy within NPSNN [REF 12-1] is in paragraph 5.195, which states ”The Secretary of State should not grant development consent unless satisfied that the proposals will meet the following aims, within the context of Government policy on sustainable development:

a. *avoid significant adverse impacts on health and quality of life from noise as a result of the new development;*

b. *mitigate and minimise other adverse impacts on health and quality of life from noise from the new development; and*

c. *contribute to improvements to health and quality of life through the effective management and control of noise, where possible.*”

12.9.90 To maintain consistency with the terminology defined in Section 12.3 and used throughout this assessment, the discussion below refers to adverse effects rather than impacts.

12.9.91 With regards to identifying sustainable mitigation measures, factors including the cost versus the benefit, engineering practicality, any other impacts (such as landscape/visual) and consultation/stakeholder engagement responses are considered.

Construction

12.9.92 Significant adverse effects occur for construction noise and vibration levels above the SOAEL (see **Table 12.2**) which potentially occur for ten or more days in 15, or more than 40 days in six months. Adverse effects occur at construction noise or vibration levels between the LOAEL and SOAEL. The third aim applies to all construction noise levels.

12.9.93 With regard to the first aim, a significant adverse effect is predicted at this stage at receptors in close proximity to C3 Woodside, Solihull Road, C5 The Dale, Catherine-de-Barnes Lane, C6 Rose Cottage, St Peter’s Lane, C8 1 Clock Cottage, Clock Lane, C10 [redacted] Church Lane, C11 [redacted] Wyckhams Close and C16 [redacted] This is due to the close proximity of these receptors to construction activities and the duration of the works. The assessment includes a range of mitigation measures as outlined in the OEMP [**TR0100027/APP/6.11**]. The mitigation measures and policies on noise insulation and temporary re-housing during construction will be set out in the Contractor’s CEMP.

12.9.94 As detailed in the OEMP, the appointed Contractor will review the proposed working methods to consider all sustainable mitigation measures, with the aim of avoiding significant effects. However, at this stage it is anticipated that some significant adverse effects are likely to remain. This is acceptable in the context of sustainable development as factors including engineering practicality, cost versus benefit etc., as outlined above, must be considered. On this basis the first aim is met during construction.

12.9.95 With regard to the second aim, adverse effects between the LOAEL and SOAEL are predicted at this stage at a range of receptors. The mitigation and minimisation measures outlined within the OEMP [**TR010027/APP/6.11**] will be applied throughout the works, and therefore will benefit all receptors experiencing construction noise or vibration, including those with levels between the LOAEL and SOAEL. Construction impacts between the LOAEL and SOAEL are acceptable in the context of sustainable development as factors including engineering practicality, cost versus benefit etc., as outlined above, must be considered. On the basis of the above mitigation and minimisation measures, the second aim is met during construction.

12.9.96 Construction noise and vibration by its nature introduces a new noise or vibration source into the existing environment and is temporary in duration, therefore the opportunity to improve existing noise levels are very limited.

Operation

12.9.97 Significant adverse operational effects occur at traffic noise levels above the SOAEL (see **Table 12.7)** and adverse effects occur at traffic noise levels between the LOAEL and SOAEL. The third aim applies to all traffic noise levels. **Table 12.23** details the number of residential buildings in the study area which are above the SOAEL with and without the Scheme. All of the remaining residential buildings are between the LOAEL and SOAEL with and without the Scheme as the night time LOAEL is set at a low level.

12.9.98 With regard to the first aim, the embedded mitigation measures incorporated within the Scheme have reduced traffic noise levels from above the SOAEL to below the SOAEL at eight properties in the vicinity of the Scheme (see Section 12.8).

12.9.99 All of the remaining residential buildings above the SOAEL following the opening of the Scheme are in close proximity to main roads and junctions such as M42 Junction 6 and A45 near Clock Interchange. Such routes are already above the SOAEL without the Scheme and experience only a negligible change in traffic noise levels due to the Scheme. The Scheme improves traffic conditions on the M42 by creating a new junction (Junction 5A) and mainline link road connecting Junction 5A and Clock Interchange. The introduction of mitigation measures along existing roads which already experience high noise levels, to mitigate the negligible effect of the Scheme, is not sustainable. For roads located at major road junctions or roundabouts, mitigation measures such as barriers are not a practical engineering option and would have other adverse impacts including visual and access difficulties.

12.9.100 With regard to the third aim to ‘improve where possible’, the Scheme improves traffic flow along the M42 and provide a mainline link road which is predominately positioned in cutting and which would divert traffic off the existing Catherine-de-Barnes Lane through Bickenhill. In the short term there is a greater number of residential properties which are predicted to experience a negligible decrease in traffic noise levels than an increase. On this basis the third aim has been met.

12.10 Monitoring

12.10.1 The assessment has concluded that the operation of the Scheme would not generate significant adverse effects, as such, no specific monitoring is required.

12.11 References

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