

# A417 Missing Link

## Preliminary Environmental Information Report

Chapter 11 Noise and Vibration

28 September 2020

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# 11 Noise and vibration

## 11.1 Introduction

- 11.1.1 This chapter of the Preliminary Environmental Information (PEI) report assesses the potential noise and vibration impacts of the construction and operation of the proposed scheme. This follows the methodology set out in the Design Manual for Roads and Bridges (DMRB), LA 111 Noise and vibration<sup>1</sup>. Annex E/1 of this Standard provides instruction on how to take account of Government Noise policy when assessing road schemes.
- 11.1.2 This chapter details the methodology followed for the assessment, summarises the regulatory and policy framework related to noise and vibration and describes the existing environment in the area surrounding the proposed scheme. Following this, the mitigation and the preliminary assessment of residual effects associated with the proposed scheme are discussed, along with the limitations of the assessment.

## 11.2 Competent expert

- 11.2.1 The Noise and Vibration lead expert holds a Diploma in Acoustics and Noise Control and an MSc in Acoustics and Noise Control. They are a Member of the Institute of Acoustics. Full details are provided in Appendix 1.2.

## 11.3 Legislative and policy framework

### Legislation, guidance and standards

- 11.3.1 Details of relevant legislation, guidance and standards have been provided in Appendix 11.5 Noise and Vibration Legislation, Guidance and Standards.

### National policy

- 11.3.2 The Government's noise policy is set out in the Noise Policy Statement for England (NPSE)<sup>2</sup>. In legislative and policy terms, noise is taken to include vibration.
- 11.3.3 Government noise policy sets three aims, which are to be met within the context of the government policy on sustainable development:
- to avoid significant adverse impacts on health and quality of life;
  - to mitigate and reduce adverse impacts on health and quality of life; and
  - where possible, contribute to the improvement of health and quality of life.
- 11.3.4 The same three aims are also reflected in:
- National Planning Policy Framework (NPPF)<sup>3</sup>.
  - Planning Practice Guidance – Noise (PPG-Noise)<sup>4</sup>.
  - National Policy Statement for National Networks (NPSNN)<sup>5</sup>.
- 11.3.5 PPG-Noise provides guidance on the application of Government noise policy. PPG-Noise notes that unacceptable adverse effects on health and quality of life

due to noise exposure (set at a level higher than significant adverse impacts on health and quality of life) should be ‘prevented’<sup>i</sup>.

- 11.3.6 Thresholds for identifying adverse effect levels in terms of Government noise policy<sup>ii</sup> are not clearly defined numerically in NPSE, NPPF, PPG-Noise, or NPSNN. Rather, the policy states that they are to be established specifically for each scheme and context depending on the local circumstances or specific receptor. The threshold values adopted for this assessment were taken from DMRB LA 111. These are set out later in this chapter (Assessment Criteria - Paragraph 11.4.28).
- 11.3.7 Particular requirements of the NPSNN in relation to noise are summarised in Table 11-1.

**Table 11-1 Relevant NPSNN policies for applicant’s noise and vibration assessment**

Relevant NPSNN paragraph reference	Requirement of the National Policy Statement for National Networks (NPSNN)	Where in the chapter is information provided to address this policy.
5.186	NPSNN states that excessive noise can impact on the ‘...use and enjoyment of areas of value (such as quiet <i>places</i> ) and areas with high landscape quality’.	‘Assessment of effects’, Section 11.10, - ‘Non-residential sensitive receptors’, 11.10.30 (construction) and 11.10.90 (operation).
5.187	Noise resulting from a proposed development can also have adverse impacts on wildlife and biodiversity. Noise effects of the proposed development on ecological receptors should be assessed in accordance with the Biodiversity and Geological Conservation section of this National Policy Statement (NPS).	The noise impact data from this assessment has been used in Chapter 8 Biodiversity.
5.188	NPSNN notes that the degree of noise impact will depend on the:  ‘proximity of the proposed development to quiet places and other areas that are particularly valued for their tranquillity, acoustic environment or landscape quality such as National Parks, the Broads or Areas of Outstanding Natural Beauty’; and  ‘the proximity of the proposed development to designated sites where noise may have an adverse impact on the special features of interest, protected species or other wildlife.’	‘Assessment of effects’, Section 11.10, - ‘Non-residential sensitive receptors’, 11.10.30 (construction) and 11.10.90 (operation).

<sup>i</sup> PPG-N defines an unacceptable adverse effect as ‘present and very disruptive’, with outcomes described as ‘Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory’.

<sup>ii</sup> i.e. adverse effects, significant adverse effects and unacceptable adverse effects on health and quality of life.

Relevant NPSNN paragraph reference	Requirement of the National Policy Statement for National Networks (NPSNN)	Where in the chapter is information provided to address this policy.
5.189	<p>Where a development is subject to EIA and significant noise impacts are likely to arise from the proposed development, the applicant should include the following in the noise assessment, which should form part of the environment statement:</p> <ul style="list-style-type: none"> <li>• a description of the noise sources including likely usage in terms of number of movements, fleet mix and diurnal pattern. For any associated fixed structures, such as ventilation fans for tunnels, information about the noise sources including the identification of any distinctive tonal, impulsive or low frequency characteristics of the noise. <i>[cont. below]</i></li> </ul>	'Assessment assumptions and limitations', Section 11.5
	<ul style="list-style-type: none"> <li>• identification of noise sensitive premises and noise sensitive areas that may be affected.</li> </ul>	'Value of receptor', 11.4.1
	<ul style="list-style-type: none"> <li>• the characteristics of the existing noise environment.</li> </ul>	'Baseline conditions', Section 11.7
	<ul style="list-style-type: none"> <li>• a prediction on how the noise environment will change with the proposed development: <ul style="list-style-type: none"> <li>○ in the shorter term such as during the construction period;</li> <li>○ in the longer term during the operating life of the infrastructure; and</li> <li>○ at particular times of the day, evening and night as appropriate.</li> </ul> </li> </ul>	<p>Construction: 11.10.10,</p> <p>Operation: 11.10.68, Appendix 11.4</p> <p>Above sections describe day and night effects</p>
	<ul style="list-style-type: none"> <li>• an assessment of the effect of predicted changes in the noise environment on any noise sensitive premises and noise sensitive areas.</li> </ul>	<p>Construction: 11.10.10</p> <p>Operation: 11.10.78, Table 11-23</p>
	<ul style="list-style-type: none"> <li>• measures to be employed in mitigating the effects of noise. Applicants should consider using best available techniques to reduce noise impacts.</li> </ul>	<p>'Design, mitigation and enhancement measures', Section 11.9, and</p> <p>Construction: 11.10.50</p> <p>Operation: 11.10.102</p>

Relevant NPSNN paragraph reference	Requirement of the National Policy Statement for National Networks (NPSNN)	Where in the chapter is information provided to address this policy.
5.190	The potential noise impact elsewhere that is directly associated with the development, such as changes in road and rail traffic movements elsewhere on the national networks, should be considered as appropriate.	'Assessment of areas within 50m of other non-scheme road links with potential to experience short-term Basic Noise Level (BNL) change of more than 1dB', 11.10.108
5.191	Operational noise, with respect to human receptors, should be assessed using the principles of the relevant British Standards and other guidance. The prediction of road traffic noise should be based on the method described in <i>Calculation of Road Traffic Noise</i> . The prediction of noise from new railways should be based on the method described in <i>Calculation of Railway Noise</i> . For the prediction, assessment and management of construction noise, reference should be made to any relevant British Standards and other guidance which also give examples of mitigation strategies	'Magnitude of impacts', Construction: 11.4.3 Operation: 11.4.11
5.192	The applicant should consult Natural England with regard to assessment of noise on designated nature conservation sites, protected landscapes, protected species or other wildlife. The results of any noise surveys and predictions may inform the ecological assessment. The seasonality of potentially affected species in nearby sites may also need to be taken into account.	The noise impact data from this assessment has been used in Chapter 8 Biodiversity.  Heritage conservation assets have been included in the assessment of noise impacts: 'Non-residential sensitive receptors', 11.10.30 (construction) and 11.10.90 (operation).  Noise is also considered as part of a wider assessment of the scheme impacts on these receptors in Chapter 6 Cultural Heritage.
5.193	Developments must be undertaken in accordance with statutory requirements for noise. Due regard must have been given to the relevant sections of the Noise Policy Statement for England, National Planning Policy Framework and the Government's associated planning guidance on noise.	'Assessment of significance', 11.4.28
5.194	The project should demonstrate good design through optimisation of scheme layout to reduce noise emissions and, where possible, the use of landscaping, bunds or noise barriers to reduce noise transmission.	'Operation mitigation', 11.9.6

Relevant NPSNN paragraph reference	Requirement of the National Policy Statement for National Networks (NPSNN)	Where in the chapter is information provided to address this policy.
5.195	<p>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:</p> <ul style="list-style-type: none"> <li>• avoid significant adverse impacts on health and quality of life from noise as a result of the new development;</li> <li>• mitigate and minimise other adverse impacts on health and quality of life from noise from the new development; and</li> <li>• contribute to improvements to health and quality of life through the effective management and control of noise, where possible.</li> </ul>	Paragraph 11.10.112, and Table 11-25 'Proposed scheme compliance with Government policy'
5.198	<p>Mitigation measures for the project should be proportionate and reasonable and may include one or more of the following:</p> <ul style="list-style-type: none"> <li>• engineering: containment of noise generated;</li> <li>• materials: use of materials that reduce noise, (for example low noise road surfacing);</li> <li>• lay-out: adequate distance between source and noise-sensitive receptors; incorporating good design to minimise noise transmission through screening by natural or purpose built barriers; and</li> <li>• administration: specifying acceptable noise limits or times of use (e.g., in the case of railway station Public Address (PA) systems).</li> </ul>	'Design, mitigation and enhancement measures', Section 11.9, and Construction: 11.10.50 Operation: 11.10.102
5.199	<p>For most national network projects, the relevant Noise Insulation Regulations will apply. These place a duty on and provide powers to the relevant authority to offer noise mitigation through improved sound insulation to dwellings, with associated ventilation to deal with both construction and operational noise. An indication of the likely eligibility for such compensation should be included in the assessment. In extreme cases, the applicant may consider it appropriate to provide noise mitigation through the compulsory acquisition of</p>	'Noise insulation eligibility', 11.10.107



<b>Relevant NPSNN paragraph reference</b>	<b>Requirement of the National Policy Statement for National Networks (NPSNN)</b>	<b>Where in the chapter is information provided to address this policy.</b>
	affected properties in order to gain consent for what might otherwise be unacceptable development. Where mitigation is proposed to be dealt with through compulsory acquisition, such properties would have to be included within the development consent order land in relation to which compulsory acquisition powers are being sought.	
5.200	Applicants should consider opportunities to address the noise issues associated with the Important Areas as identified through the noise action planning process.	'Noise important areas', 11.10.100

## Local policy

11.3.8 Table 11-2 sets out local policy requirements and key considerations for residential communities and the Area of Outstanding Natural Beauty (AONB).

**Table 11-2 Local planning and environmental policies and strategies**

Local policy document	Extract relevant to noise and vibration assessment
Cotswold District Local Plan 2011 to 2031 <sup>6</sup>	<p>Policy EN15 Pollution and Contaminated Land</p> <p><i>'1. Development will be permitted that will not result in unacceptable risk to public health or safety, the natural environment or the amenity of existing land uses through:</i></p> <p><i>a. pollution of the air, land, surface water, or ground water sources; and/or,</i></p> <p><i>b. generation of noise or light levels (pollution), or other disturbance such as spillage, flicker, vibration, dust or smell.'</i></p> <p><i>Clause 10.15.5 under EN15: 'Noise should not give rise to significant adverse impacts on health and quality of life. Acceptable noise levels will vary according to the source, receptor and time, and the policy is not intended to unduly restrict existing established businesses which may need to develop.'</i></p>
Gloucester, Cheltenham and Tewkesbury Joint Core Strategy (JCS) 2011-2031 December 2017 <sup>7</sup>	<p>Policy SD4: Design Requirements</p> <p><i>'iii. Amenity and space;</i></p> <p><i>New development should enhance comfort, convenience and enjoyment through assessment of the opportunities for light, privacy and external space, and the avoidance or mitigation of potential disturbances, including visual intrusion, noise, smell and pollution.'</i></p>
Draft Tewkesbury Borough Plan 2011-2031 <sup>8</sup>	<p>Policy ENV1 Special Landscape Areas</p> <p><i>'Proposals must demonstrate that they do not adversely affect the quality of the natural and built environment, its visual attractiveness, wildlife and ecology, or detract from the quiet enjoyment of the countryside.'</i></p>
Cotswolds AONB Management Plan 2018-2023 <sup>9</sup>	<p>Outcome 6 (Tranquillity):</p> <p><i>'The tranquillity of the Cotswolds AONB will have been conserved and enhanced, with fewer areas being affected by noise pollution and other aural and visual disturbance.'</i></p> <p>Policy CE4: Tranquillity</p> <p><i>'1. Proposals that are likely to impact on the tranquillity of the Cotswolds AONB should have regard to this tranquillity, by seeking to (i) avoid and (ii) reduce noise pollution and other aural and visual disturbance.</i></p> <p><i>2. Measures should be taken to enhance the tranquillity of the Cotswolds AONB by (i) removing and (ii) reducing existing sources of noise pollution and other aural and visual disturbance.'</i></p>

Local policy document	Extract relevant to noise and vibration assessment
	<i>'Policy CE4 has an emphasis on noise. This incorporates issues such as significant increases in traffic in the towns, villages and smaller settlements of the AONB, including increased traffic arising from developments outside of the AONB.'</i>
<p>Cotswolds AONB Position Statements<sup>10</sup></p> <p>Position Statement (2019) on Dark Skies &amp; Artificial Light<sup>11</sup>:</p> <p>Position Statement (2016) on Development in the setting of the Cotswolds AONB<sup>12</sup>:</p>	<p>Position Statement (2019) on Dark Skies &amp; Artificial Light UK Government Policy and National and Local Planning Policies</p> <p>The Position Statement cites the Government's Rural White Paper published in 2003 which observed that: <i>"It is not just its physical features which give the countryside its unique character; there are also less tangible features such as ... dark skies and remoteness from the visible impact of civilisation."</i></p> <p><i>The White Paper went on to state that: "Increased measures will be taken to promote tranquillity". Influences on tranquillity in the countryside identified in the White Paper included light pollution.'</i></p> <p>Position Statement (2016) on Development in the setting of the Cotswolds AONB.</p>
<p>Position Statement (2015) on Public Rights of Way<sup>13</sup>:</p>	<p><i>'Development proposals that affect views into and out of the AONB need to be carefully assessed to ensure that they conserve and enhance the natural beauty and landscape character of the AONB.'</i></p> <p><i>'The level of harm from any proposal does [...] have to be considered and expressed in terms of: (i) harm directly to land in the designated AONB itself which is the significant issue and (ii) [...] harm to land outside the designated AONB that is viewed in the context or backdrop of the AONB.'</i></p> <p>Position Statement (2015) on Public Rights of Way</p> <p><i>'Highway Authorities have a duty to have regard to the purposes of AONB designation and all the councils have endorsed the Cotswolds AONB Management Plan.'</i></p> <p><i>'Highway authorities also have a duty to prepare a Rights of Way Improvement Plan (ROWIP). The ROWIP, some of which are now part of the authorities' Local Transport Plan, must consider what the current and likely future needs of the public are, and present proposals for how the authority will improve the network to meet those needs.'</i></p> <p><i>'The public rights of way network is the main way for residents and visitors to explore and enjoy the Cotswolds and is important to the area's economy. The Board therefore expects to see a safe, pleasant, well maintained, clearly waymarked and better-connected PRoW network available for all, making the Cotswolds AONB a place for positive, high quality experiences. An adequate network is needed for walkers, cyclists (on- and off-road), horse riders and carriage drivers.'</i></p>
<p>Cotswolds Conservation Board Position Statement – Tranquillity (2019)<sup>14</sup></p>	<p>The Position Statement makes multiple recommendations to preserve and enhance tranquillity in the Cotswolds AONB. Tranquillity is defined, in part, as <i>'a state of calm and quietude'</i> that is <i>'free from man-made noise'</i>. Tranquillity is <i>'one of the features of the Cotswolds that makes the area so outstanding that it is in the nation's interest to safeguard it.'</i> The Statement notes that tranquillity is the basis for the enjoyment of other special qualities in the AONB and cites survey evidence that tranquillity ranks number 1 as the quality people value in the countryside.</p>

Local policy document	Extract relevant to noise and vibration assessment
	<p>The Position Statement expands the Cotswolds AONB Management Plan 2018-202, Policy CE4 (Tranquillity), which states that proposals impacting on tranquillity should <i>'(i) avoid and (ii) reduce noise pollution and other aural and visual disturbance'</i>, as well as enhance the tranquillity of the AONB by <i>'(i) removing and (ii) reducing existing sources of noise pollution'</i>.</p> <p>With regard to highway noise, the recommendation aligns closely with the Government's Noise Policy Statement (NPS) for England and associated policy documents<sup>iii</sup>:</p> <p><i>'The Board recommends that Highways England and other highways authorities should ensure that highway schemes within the Cotswolds AONB support the aims of the Noise Policy Statement (NPS) for England:</i></p> <ul style="list-style-type: none"> <li>• <i>To avoid significant adverse noise effects</i></li> <li>• <i>To mitigate and reduce adverse noise effects</i></li> <li>• <i>To improve the noise environment where possible'</i></li> </ul> <p>Additionally, a recommendation is made about noise levels on minor roads since significant noise levels can be generated by higher traffic levels and/or larger, noisier vehicles such as HGVs (heavy goods vehicles):</p> <p><i>'The Board recommends that proposals that have the potential to affect the tranquillity of minor roads should assess baseline and anticipated noise levels on such roads.</i></p>

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<sup>iii</sup> See paragraph 11.3.4 of this chapter.

## 11.4 Assessment methodology

### Value of receptor

- 11.4.1 In addition to residential receptors, LA 111 identifies a range of non-residential properties as noise sensitive, which should also be considered in the assessment. These include hospitals, healthcare facilities, education facilities, community facilities, Environmental Noise Directive (END)<sup>15</sup> quiet areas or potential END quiet areas, international and national or statutorily designated sites, public rights of way and cultural heritage assets.
- 11.4.2 LA 111 does not specifically assign levels of sensitivity to different types of noise sensitive receptor. However, sensitivity has been considered in the assessment based on the use of the receptor, and the context of the impact (e.g. times of use of the receptor), as is common practice for noise assessment.

### Magnitude of impacts

#### Construction noise

- 11.4.3 The noise assessment from the construction of the proposed scheme has been determined according to LA 111 using BS 5228–1:2009+A1:2014<sup>16</sup> (referenced within LA 111). This standard provides information on the prevention and control of construction noise and includes a procedure for predicting construction noise. Calculations of noise levels at selected receptors have been based on typical noise levels for construction processes (mainly taken from BS 5228). Calculations also take account of propagation distance, details of the intervening ground cover, and topography and screening.
- 11.4.4 The assessments have been undertaken at locations that may be representative of several dwellings or other sensitive receptors. For groups of properties, receptors are chosen to be representative of the worst-case (most exposed) location in the group of properties. Where a receptor has multiple uses the assessment has been made based on the most sensitive use.
- 11.4.5 Daytime construction noise levels have been predicted as the logarithmic average over a period of a month as an  $L_{Aeq,T}$ <sup>iv</sup>. The predictions consider the likely variation in the programme and the working area for the period assessed. The assessment results present the range of monthly noise levels (according to the range of construction activities) for a specified assessment location.
- 11.4.6 The predictions are presented as façade levels relating to a position 1m from the building, or as a free-field<sup>v</sup> level for sensitive receptors in open spaces such as country parks, outdoor amenity areas or some heritage assets. The assessment considers the range of average monthly noise levels at sensitive receptor locations, but construction noise levels would vary day-to-day.
- 11.4.7 Many of the construction processes would move progressively along the line of route. For these processes, noise levels have been considered for the worst-case month, i.e. when the process is closest to the receptor, and the point furthest from the receptor within the same month to derive an average monthly noise level.

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<sup>iv</sup> The equivalent continuous sound level ( $L_{Aeq,T}$ ) is the level of a notional steady sound, which at a given position and over a defined period of time (T), would have the same A-weighted acoustic energy as the fluctuating noise.

<sup>v</sup> Free Field: An external sound field in which no significant sound reflections occur (apart from the ground).

- 11.4.8 Construction activity will mainly take place during the daytime but there will be occasional work at night during full road closures where it is required to work on, or over, a carriageway, e.g. installing or removing traffic management measures or installing a bridge over the carriageway. A night-time noise assessment has been undertaken for these activities for the closest receptors to where they will occur. Unlike daytime, noise has been assessed for an individual worst-case night taking into account plant movement in a limited area. Once impacts have been determined, consideration has been given as to whether these impacts could be significant taking into account the likely duration of impact.

#### Construction vibration

- 11.4.9 Groundborne vibration during the construction of the proposed scheme may potentially arise due to the use of percussive rock-breaking machinery, compaction plant, or percussive piling if it were necessary. Impacts at sensitive receptors will be dependent on their proximity to the works, the intensity with which the equipment is operated and the intervening ground conditions.
- 11.4.10 BS 5228–2:2009+A1:2014 provides a methodology for predicting typical levels of vibration from certain types of construction activities, based on case study data and empirical models. This has been used where appropriate to consider the likelihood that vibration from the works may exceed the thresholds for perception and disturbance.

#### Operational noise

- 11.4.11 Traffic noise level calculations were carried out according to LA 111 using the Calculation of Road Traffic Noise (CRTN)<sup>17</sup> methodology (referenced within LA 111). Noise levels were calculated across a grid of receptor positions over the study area to produce contours of noise level exposure. Additional calculations were also conducted at specific assessment locations to represent noise sensitive receptors (e.g. residential properties). The study area according to LA 111 is defined in paragraph 11.6.1 and shown in report Figure 11.1. The noise contours shown on Figure 11.1 are representative of the noise levels at 4m above local ground level (i.e. first-floor level for a typical house, generally worst case in terms of exposure to the highway).
- 11.4.12 The traffic data used in the model were those forecasted under the ‘Do-Something’ and ‘Do-Minimum’ scenarios<sup>vi</sup> in the baseline year, and those in the future assessment year. The ‘baseline year’ is defined in DMRB LA 104<sup>18</sup> as representing the conditions prior to implementation of the project, in this case taken as 2024 for operation. The future assessment year is defined in LA 111 as between opening and the 15<sup>th</sup> year of operation, in this case, the design year (2039).
- 11.4.13 It is noted that the modelled years do not coincide with the revised opening and design year for the proposed scheme. It is considered that this does not materially affect the results of the assessments undertaken as the relative traffic change associated with proposed scheme would be equivalent. The traffic modelling approach and data verification would be described in the Transport Report which will be submitted as part of the DCO.

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<sup>vi</sup> DMRB terms for assessment scenarios, i.e. ‘Do-Something’ being with scheme and ‘Do-Minimum’ being without-scheme.

- 11.4.14 For the purposes of this assessment, the  $L_{A10,18h}$  results are converted to the corresponding  $L_{Aeq}$  scale for daytime noise, i.e.  $L_{Aeq,16h}$  (see Glossary in Appendix 11.1). This provides a direct comparison with the quantitative  $L_{Aeq}$  criteria described later for assessing significance with respect to the Government's noise policy (NPSE). The  $L_{Aeq,16h}$  scale has also been adopted for traffic noise assessment as part of the government's WebTAG<sup>19</sup> methodology for environmental impact assessment, which will be undertaken alongside the Environmental Statement (ES).
- 11.4.15 Baseline noise survey results and the baseline noise survey report (Appendix 11.2) have been reviewed to provide indicative data to inform the predicted noise climates, across the study area.
- 11.4.16 The assessment has considered short-term and long-term noise impacts as described in LA 111. The long-term change (i.e. with-scheme 2039 (Do-Something) vs without-scheme 2024 (Do-Minimum) is the likely worst-case considering traffic growth that represents the permanent effect of the scheme. The Do-Minimum 'future assessment' year (i.e. design year) was also considered to determine whether any effects identified are as a consequence of traffic growth.
- 11.4.17 Eligibility for sound insulation measures under the Noise Insulation Regulations 1975 (as amended 1988)<sup>20</sup>, as referenced in LA 111, has been considered to identify any residential dwellings that would potentially qualify under the Regulations.

#### Operational night-time noise

- 11.4.18 The LA 111 methodology requires that night-time noise is also assessed. The  $L_{night}$  descriptor is used to represent the noise level at dwellings between the hours of 23:00 and 07:00. Method three from the Transport Research Laboratory (TRL) report PR/SE/451/02<sup>21</sup> was used for predicting  $L_{night}$  noise levels. Method three uses daily traffic flow data converting predicted daytime noise levels ( $L_{A10,18h}$ ) to night-time noise levels. This method was considered appropriate as there was nothing atypical in the proportionate traffic flow volumes for this route between daytime and night-time<sup>vii</sup>.
- 11.4.19 The assessment of impact magnitude for night-time noise follows the same method as that for daytime.

### **Assessment of significance**

#### Approach to assessment of effects – all sources and receptors

- 11.4.20 The method for identifying likely significant effects of noise and vibration from construction and operation of the proposed scheme, as required by the EIA Regulations, is aligned with LA 111 and Government noise policy.
- 11.4.21 It follows from Government noise policy NPSE, PPG-Noise and NPSNN that thresholds should be set to define the onset of the following levels of effect:
- Significant Observed Adverse Effect Levels (SOAEL) to identify the onset of significant impacts on health and quality of life;

<sup>vii</sup> Appendix A2 of LA 111 notes that TRL Method 3 provides reliable results for most UK roads. Exceptions to this can include roads where the proportion of night-time traffic to daytime traffic is atypical.

- Lowest Observed Adverse Effect Levels (LOAEL) to identify the onset of adverse impact on health and quality of life.

#### Significant adverse effects on health and quality of life

- 11.4.22 Where the calculated noise or vibration indicates a significant adverse impact on health and quality of life (i.e. the noise level exceeds the relevant SOAEL threshold – criteria defined in Table 11-4 to Table 11-11), then this is assessed as a likely 'significant observed adverse effect' at each receptor<sup>viii</sup>. Above this threshold, such noise levels are perceived as '*present and disruptive*' according to the assessment framework given in PPG-Noise. The NPSE states that these effects should be *avoided*.

#### Adverse effects on health and quality of life

- 11.4.23 The assessment will also identify likely significant effects where the calculated noise or vibration is less than the SOAEL but greater than the relevant LOAEL. Between these thresholds, such noise levels are perceived as '*present and intrusive*' according to the assessment framework given in PPG-Noise. The NPSE states that these effects should be *mitigated and reduced to a minimum*.
- 11.4.24 These effects are identified in this assessment as likely 'significant adverse effects'. This describes effects at lower noise exposures that are an adverse impact on health and quality of life and are assessed as significant in the EIA, but which are not significant in terms of Government noise policy (paragraph 11.4.21).
- 11.4.25 In this case, the basis for assessing a likely significant effect is primarily the change in noise caused by the proposed scheme, with consideration of other factors such as the existing level of noise exposure, and the noise sensitive parts of the receptor that are affected.
- 11.4.26 Table 11-3 summarises how noise levels in terms of Government noise policy and change in noise levels have been used to identify likely significant effects.
- 11.4.27 The criteria used to assess the significance of the above effects for different receptor types and noise exposure levels are described in the section "Assessment criteria" (11.4.28).

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<sup>viii</sup> Any beneficial effects would also be identified due to noise reductions.



**Table 11-3 Noise and vibration assessment approach to address both the EIA and Government policy requirements**

	Perception	Government policy		EIA		Mitigation		
		Effect	Action	Assessment	Effect	Project	Receptor	
Increasing level of noise or vibration ↓	Not present	No observed effect	No specific measures required	Special cases (see paragraph 11.4.43)	No adverse effect	Special cases	None	
	Present and not intrusive	No observed adverse effect	No specific measures required					
	<b>Lowest observed adverse effect level – LOAEL</b>							
	Present and intrusive	Observed adverse effect	Mitigate and reduce to a minimum	Noise level change as indicator of impact magnitude + contextual significance criteria	Change or absolute level may cause <u>adverse effect</u> on acoustic character. May be considered significant in EIA terms	Maximise mitigation as far as sustainable	None	
	<b>Significant observed adverse effect level – SOAEL</b>							
	Present and disruptive	Significant observed adverse effect	Avoid	Exceeding SOAEL is a significant effect	Significant <u>adverse effect</u>	Maximise mitigation as far as sustainable . Prevent UAELs	Noise insulation	
Present and very disruptive	Unacceptable adverse effect	Prevent	Exceeding UAEL is a significant effect	Potentially re-house where noise is from the scheme				

Assessment criteria

11.4.28 The assessment uses criteria as set out in LA 111 that responds to the requirements of:

- Government policy set out in NPSE, NPPF, NPSNN and PPG- Noise;
- relevant regulations, guidance and standards; and
- best practice as set by previous relevant projects.

*Construction noise assessment criteria*

11.4.29 Potential adverse effect thresholds in Government policy terms have been established based upon the ABC Method described in BS5228-1:2009+A1:2014. These thresholds, described in Table 11-4, have been used to establish assessment criteria for monthly average construction noise levels. The numerical thresholds for the ABC method are defined in Table 11-5. These criteria have been used to derive LOAEL and SOAEL thresholds for this assessment.

**Table 11-4 LOAEL and SOAEL thresholds for construction noise at all receptors in terms of Government policy (from LA 111)**

Time period	LOAEL	SOAEL	Notes
Day (0700-1900 weekday and 0700-1300 Saturdays)	Baseline noise levels $L_{Aeq,T}$	Threshold level determined as per BS 5228-1 Section E3.2 and Table E.1 (see below)	LOAEL is set at a level where construction noise becomes the dominant source. SOAEL is set where construction noise exceeds BS5228 thresholds, Table E.1 (see Table 11-5). Existing noise level shall be determined based on ambient noise monitoring, noise model prediction or estimation based on published noise level datasets (for example Defra Noise Mapping <sup>22</sup> ).
Night (2300-0700)	Baseline noise levels $L_{Aeq,T}$	Threshold level determined as per BS 5228-1 Section E3.2 and Table E.1	
Evening and weekends (time periods not covered above)	Baseline noise levels $L_{Aeq,T}$	Threshold level determined as per BS 5228:2009 + A2014 section E3.2 and Table E.1	

11.4.30 The threshold of potential adverse effect described in Table E.1 of BS5228-1:2009+A1:2014 according to the ABC method is reproduced in Table 11-5.

**Table 11-5 Threshold of potential significant effect at dwellings according to ABC method (from Table E.1, BS 5228–1:2009 + A1:2014)**

Assessment category and threshold value period	Threshold value, dB(A)		
	Category A	Category B	Category C
Night-time (23:00 – 07:00)	45	50	55
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75
Other: Weekday evenings (19:00 – 23:00) Saturdays (13:00 – 23:00) Sundays (07:00 – 23:00)	55	60	65

Category A: threshold value to use when ambient noise levels (rounded to the nearest 5dB) are less than these values  
Category B: threshold value to use when ambient noise levels (rounded to the nearest 5dB) are the same as Category A values  
Category C: threshold value to use when ambient noise levels (rounded to the nearest 5dB) are higher than Category A values.

11.4.31 Using the LA 111 methodology, the construction noise impact level is determined from Table 11-6.

**Table 11-6 Magnitude of impact and construction noise descriptions (from LA 111)**

Magnitude of impact	Construction noise level
Major	Above or equal to SOAEL +5dB
Moderate	Above or equal to SOAEL and below SOAEL +5dB
Minor	Above or equal to LOAEL and below SOAEL
Negligible	Below LOAEL

11.4.32 Construction traffic BNL increases have been calculated for roads within the construction traffic study area. The magnitude of impact is then determined using Table 11-7.

**Table 11-7 Magnitude of impact for construction traffic noise (from LA 111)**

Magnitude of impact	Increase in Basic Noise Level (BNL) of closest public road used for construction traffic (dB)
Major	Greater than or equal to 5.0
Moderate	Greater than or equal to 3.0 and less than 5.0
Minor	Greater than or equal to 1.0 and less than 3.0
Negligible	Less than 1.0

11.4.33 For diversion routes used at night, a major magnitude of impact for construction noise impact is determined at any noise sensitive receptors within the diversion route study area<sup>ix</sup>.

11.4.34 From LA 111, construction noise and construction traffic noise is taken as a significant effect for all noise sensitive receptors where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:

- ten or more days or nights in any 15 consecutive days or nights; or
- a total number of days exceeding 40 in any six consecutive months.

#### *Construction vibration assessment criteria*

11.4.35 BS 5228-2:2009+A1:2014<sup>23</sup>, section B2 and Table B.1, states that Peak Particle Velocity (PPV) vibration levels are considered to be an appropriate vibration parameter to be used when considering construction vibration, and the Standard provides guidance upon the 'instantaneous' human response to vibration in buildings in terms of overall vibration velocity levels (Table 11-8)<sup>x</sup>. These criteria have been used to derive LOAEL and SOAEL thresholds for this assessment.

**Table 11-8 LOAEL and SOAEL thresholds of likely effects of vibration for building occupants (from LA 111, derived from BS 5228-2:2009+A1:2014)**

Time period	LOAEL	SOAEL	Notes
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<sup>ix</sup> Defined in paragraph 11.6.4.

<sup>x</sup> BS 5228-2 notes in Table B.1: 'The values are provided to give an initial indication of potential effects, and where these values are routinely measured or expected then an assessment in accordance with BS 6472-1 or -2, and/or other available guidance, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment.' Consideration has been given to other guidance with regard to time varying exposure where appropriate – the BS 6472 guidance makes use of the 'Vibration Dose Value' metric (VDV).

Time period	LOAEL	SOAEL	Notes
All time periods	0.3mm/s PPV	1.0mm/s PPV	LOAEL is set at the lowest level at which vibration may be perceptible in residential environments. SOAEL is set where levels can be tolerated with prior warning (ref BS5228:2).

11.4.36 Using the LA 111 methodology, the construction vibration impact level is determined from Table 11-9.

**Table 11-9 Magnitude of impact and vibration level (from LA 111)**

Magnitude of impact	Construction noise level
Major	Above or equal to 10mm/s
Moderate	Above or equal to SOAEL and below 10mm/s PPV
Minor	Above or equal to LOAEL and below SOAEL
Negligible	Below LOAEL

11.4.37 Construction noise and construction traffic noise is taken as a significant effect for all noise sensitive receptors where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:

- ten or more days or nights in any 15 consecutive days or nights; or
- a total number of days exceeding 40 in any six consecutive months.

11.4.38 Risk of damage to buildings from groundborne vibration is assessed using the criteria in Table 11-10. The criteria are derived from BS 5228 Part 2 and BS 7385, Part 2<sup>24</sup>. This ensures there is no risk of the lowest damage category ('cosmetic') being exceeded, as defined in BS ISO 4866<sup>25</sup>. However, effects in terms of even cosmetic damage to buildings would occur only for vibration exposures much higher than the lowest perceptible levels.

**Table 11-10 Vibration impact criteria for buildings (conservative criteria below which there is no risk of cosmetic damage)**

Category of building	Peak particle velocity <sup>1</sup> (mm/s)	
	Transient <sup>2</sup> vibration	Continuous <sup>3</sup> vibration
Potentially vulnerable building	6	3
Structurally sound buildings	12	6

Notes:  
<sup>1</sup> At the building foundation  
<sup>2</sup> Transient relative to building response e.g. from percussive piling  
<sup>3</sup> Continuous relative to building response e.g. from vibratory piling, vibrating rollers

#### *Operational noise assessment criteria*

11.4.39 Adverse effect levels have been set in accordance with DMRB LA 111 and Government noise policy (NPPF, NPSE, NPSNN, and PPG-Noise) and. The thresholds also relate to the guidance from the World Health Organization Guidelines for Community Noise<sup>26</sup>, WHO Night Noise Guidelines for Europe<sup>27</sup>, WHO Environmental Noise Guidelines<sup>28</sup>, the Noise Insulation Regulations 1975

(as amended), and best practice from other projects. These criteria have been used to derive LOAEL and SOAEL thresholds for this assessment.

**Table 11-11 Operational noise LOAELs and SOAELs for all receptors (from LA 111)**

Time period	LOAEL	SOAEL	Notes
Day (06:00-24:00)	55dB <sub>L<sub>A10,18h</sub></sub> (façade)  50dB <sub>L<sub>Aeq,16h</sub></sub> (free-field)	68dB <sub>L<sub>A10,18h</sub></sub> (façade)  63dB <sub>L<sub>Aeq,16h</sub></sub> (free-field)	The daytime LOAEL is based on the onset of moderate community annoyance, and the daytime SOAEL is based on the onset of cardiovascular health effects (ref. WHO Guidance <sup>xi</sup> ) and the Noise Insulation Regulation threshold.
Night	40dB <sub>L<sub>Aeq,8hr</sub></sub> L <sub>night,outside</sub> (free-field)	55dB <sub>L<sub>Aeq,8hr</sub></sub> L <sub>night,outside</sub> (free-field)	The night time LOAEL is defined using the WHO Night Noise Guidelines, and the night time SOAEL is equivalent to the levels above which cardio vascular health effects become the major public health concern (ref. WHO Night Noise Guidelines).

11.4.40 The magnitude of the impact and effect caused by short-term and long-term change in noise levels attributable to the proposed scheme is evaluated in accordance with Table 11-12 and Table 11-13 respectively.

**Table 11-12 Magnitude of noise impact in the short-term (from LA 111)**

Noise change [dB(A)]	Magnitude of impact in the short-term
0	No change
0.1 – 0.9	Negligible
1.0 – 2.9	Minor
3.0 – 4.9	Moderate
5.0 +	Major

**Table 11-13 Magnitude of noise impact in the long-term (from LA 111)**

Noise change [dB(A)]	Magnitude of impact in the long-term
0	No change
0.1 – 2.9	Negligible
3.0 – 4.9	Minor
5.0 – 9.9	Moderate
10.0 +	Major

11.4.41 The initial assessment of likely significant effect on noise sensitive buildings is determined using Table 11-14.

<sup>xi</sup> World Health Organization Guidelines for Community Noise (1999). The WHO Environmental Noise Guidelines for the European Region (2018) recommend traffic noise levels below 53dB<sub>L<sub>den</sub></sub> (i.e. day/evening/night) and 45dB<sub>L<sub>night</sub></sub> to avoid adverse health effects. It should be noted that the thresholds for lowest observed adverse effect level (LOAEL) for this assessment are set at lower noise exposures (i.e. more sensitive criteria) to represent the onset of adverse health effects associated with traffic noise.

**Table 11-14 Initial assessment of operational noise significance (from LA 111)**

Significance	Short term magnitude of change
Significant	Major
Significant	Moderate
Not significant	Minor
Not significant	Negligible

11.4.42 For noise sensitive receptors where the magnitude of change in the short term is minor, moderate or major at noise sensitive buildings, Table 11-15 shall be used, together with the output of Table 11-14 to determine final significance.

**Table 11-15 Determining final operational significance on noise sensitive buildings (from LA 111)**

Assessment factor	Local circumstance	Influence on significance judgement
1	Noise level change (is the magnitude of change close to the minor to moderate boundary?)	1) Noise level changes within one dB of the top of the 'minor' range can indicate that it is more appropriate to determine a likely significant effect. Noise level changes within one dB of the bottom of a 'moderate' range can indicate that it is more appropriate to consider a change is not a likely significant effect.
2	Differing magnitude of impact in the long term and/or future year to magnitude of impact in the short term	1) Where a greater impact in the long term and/or future year is predicted, it can be more appropriate to consider that a smaller change is a likely significant effect. A lower impact in the long-term and/or future year over the short-term can indicate that it is more appropriate to consider that a larger change is not significant.  2) A similar change in the long term and non-project noise change can indicate that the change is not due to the project and not an indication of a likely significant effect.
3	Absolute noise level with reference to LOAEL and SOAEL (by design this includes sensitivity of receptor)	1) A noise change where all do-something absolute noise levels are below SOAEL requires no modification of the initial assessment.  2) Where any do-something absolute noise levels are above the SOAEL, a noise change in the short term of 1.0dB or over results in a likely significant effect.
4	Location of noise sensitive parts of a receptor	1) If the sensitive parts of a receptor are protected from the noise source, it can be appropriate to conclude a moderate or major magnitude change in the short term and/or long term is not a likely significant effect.  2) An example of this would be where no windows of sensitive rooms face the road, and outdoor spaces are protected from the road by buildings.  3) Conversely, if the sensitive parts of the receptor are exposed to the noise source, it can be more

Assessment factor	Local circumstance	Influence on significance judgement
		<p>appropriate to conclude a minor change in the short term and/or long term is a likely significant effect.</p> <p>4) An example of this would be when a house has many windows of sensitive rooms and outdoor spaces facing the road.</p> <p>5) It will only be necessary to look in detail at individual receptors in terms of this circumstance where the decision on whether the noise change gives rise to a significant environmental effect is marginal.</p>
5	Acoustic context	1) If a project changes the acoustic character of an area, it can be appropriate to conclude a minor magnitude of change in the short term and/or long term is a likely significant effect.
6	Likely perception of change by residents	<p>1) If the project results in obvious changes to the landscape or setting of a receptor, it is likely that noise level changes will be more acutely perceived by the noise sensitive receptors. In these cases it can be appropriate to conclude that a minor change in the short term and/or long term is a likely significant effect.</p> <p>2) Conversely, if the project results in no obvious changes for the landscape, particularly if the road is not visible from the receptor, it can be appropriate to conclude that a moderate change in the short term and/or long term is not a likely significant effect.</p>

- 11.4.43 For residential receptors where noise impacts occur in areas below the LOAEL, there would be no noise effect in Government policy terms (Table 11-13). However, as noted in Table 11-3, there could be noise effects in EIA terms for special cases in very quiet residential settings. This aligns with the requirement in LA 111 to consider 'changes to the landscape or setting', as referred to in the final row of Table 11-15. The absence of man-made sound is a factor (amongst other aspects of the setting) in assessing areas as having a particularly tranquil character. Tranquillity is assessed as part of the Chapter 7 (Landscape and Visual). The tranquillity assessment has been used to identify residential areas below the LOAEL that are considered to be special cases (Table 11-3) in this assessment due to the particular sensitivity of the AONB setting with regard to noise and other impacts.
- 11.4.44 The Campaign to Protect Rural England<sup>29</sup> (CPRE) defines tranquillity as follows:
- 'The quality of calm experienced in places with mainly natural features and activities, free from disturbance from manmade ones.'*
- 11.4.45 Another definition of tranquillity is given in the Cotswolds Conservation Board (CCB) Position Statement on Tranquillity<sup>30</sup>:
- 'Tranquillity is a state of calm and quietude associated with peace, experienced in places with mainly natural features and/or historic character, free from man-made noise and other aural and visual disturbance.'*
- 11.4.46 CPRE use a 'national relative tranquillity' scale as a measure of the various positive and negative factors contributing to or detracting from the tranquillity



character of an area. For the proposed scheme study area, CPRE tranquillity maps have been reproduced in Figure 7.8 of Chapter 7 (Landscape and Visual). These maps have been used to identify any residential receptors in the noise impact study area with relatively high tranquillity character, and any such receptors will be assessed as special cases when considering noise impact below the LOAEL in any particularly sensitive settings.

- 11.4.47 Outdoor sensitive receptors in very quiet locations, such as PRoWs below the LOAEL, where the existing environment is characterised by little or no appreciable man-made sound sources, may be considered rare in the national context. Hence, these outdoor amenity receptors may be assessed as special cases in the AONB.

### **Stakeholder engagement**

- 11.4.48 A request was made to Gloucestershire County Council, Tewkesbury District Council, and Cotswold District Council to consult on the methodology and any noise and vibration sensitivities within the study area. The Highways England noise specialist spoke with the Environmental Health Officer at Tewkesbury District Council to explain the assessment methods. The EHO at Tewkesbury District Council reported that they accepted the assessment approach. A written response was also obtained from Cotswold District Council, which is the local authority area within which the larger part of the proposed scheme would be, including the major realignment around Birdlip to the west, and Cowley and Coberley to the east. These consultation exchanges will be documented in a Statement of Common Ground with the Joint Councils as part of the DCO application.
- 11.4.49 The Cotswold District Council response noted that for construction noise and vibration, control criteria may be imposed in Prior Consent applications under Control of Pollution Act 1974. The DCO would secure the agreed control criteria as part of the Environmental Management Plan (EMP) to be provided as part of DCO application. The Council's requirements for construction working hours are commonly 8:00-18:00 Mon-Fri, 8:00-13:00 Sat. Any concessions to these hours for particular activities where out-of-hours work is essential, would be controlled through the Control of Pollution Act 1974 'Prior consent' applications. Cotswold District Council noted in particular that the code of practice to be developed by the applicant for construction works should include the following considerations:
- The parking of vehicles for site operatives and visitors.
  - The loading and unloading of plant and materials.
  - The storage of plant and materials used in constructing the development.
  - The erection and maintenance of security hoarding including decorative displays.
  - Wheel washing facilities.
  - Measures to control the emission of dust and dirt during construction.
  - A scheme for recycling or disposing of waste resulting from demolition and construction works.
- 11.4.50 For operational noise assessment, Cotswold District Council noted that DMRB highway noise assessment methodology (LA 111) would be appropriate to assess noise effects to noise sensitive receptors potentially impacted by the proposed scheme.



- 11.4.51 The Planning Inspectorate (PINS) were consulted during the scoping stage and provided an opinion<sup>31</sup>. The PINS responses have been considered and included, where appropriate, in this chapter.
- 11.4.52 The PINS Scoping Opinion noted the requirement to comply with the relevant guidance and planning policy in relation noise and vibration assessment. PINS highlighted the need to consider cultural heritage assets and Special Areas of Conservation within the AONB. Also, in combination effects with respect to 'effects to landscape and tranquillity' should be considered, and the combined effects 'to the settings of cultural heritage assets'.
- 11.4.53 During the 2019 public consultation, comments were received from stakeholders that the PEI Report had not included noise assessment results for Cowley and Coberley, both to the east of the study area. For the PEI report, these areas have been fully included in the assessment and are shown on the noise contour mapping (Figures 11.1-11.4). The revised DMRB assessment methodology (LA 111) for determining the noise study area is summarised in paragraph 11.6.7.

## 11.5 Assessment assumptions and limitations

### Construction

- 11.5.1 Appropriate assumptions have been developed as to the type and number of construction plant and the intensity and duration of the construction processes for the proposed scheme. These data have been based on the construction activities that would be required for the various stages of the proposed scheme (excavation, earthworks and structures, among others). Data have also been used from similar highway construction works where appropriate detailed construction method data was available. This data has been reviewed with the construction logistics specialists to reflect the appropriate scale of works for each part of the proposed scheme. This includes locations of key areas of intensive works (with regard to noise and vibration, such as piling works for structures and mitigation opportunities). The assumptions are shown in Appendix 11.3.
- 11.5.2 When scheme contractors have developed a full construction method statement, more detailed information on programme and processes will be available. However, the current construction method assumptions are considered to be representative of the scale and intensity of the works, and these are suitable for this PEI Report.
- 11.5.3 Key assumptions and limitations of the prediction method are shown in Table 11-16, together with likely implications.

**Table 11-16 Key assumptions, limitations and implications for the construction assessment**

Assumption or limitation	Implication for Assessment
Where there are multiple items of identical 'static' plant, these were assumed to be situated in one location closest to the nearest sensitive receptor(s). For multiple items of identical 'Mobile Plant' the closest traverse paths have been considered relative to the nearest sensitive receptor(s).	For both 'Static' and 'Mobile' plant sources in very close proximity to sensitive receptors, this can cause an over-prediction of the worst-case noise level, however, for more distant receptors it more closely reflects the true situation.
Rate of progression for daytime activities has been based on the proposed high-level programme. Night-time construction activities have been assumed to move within a defined area of each junction, or traffic management area, during a typical night-time.	Works may proceed more quickly or more slowly adjacent to any particular receptor hence altering the duration and level of impact.
The more distant routes for vehicles accessing the site is currently unknown beyond the use of the A417 immediately to the north and south of the site.	Were the vehicles to transit onto roads with much lower flows, speeds and percentages of heavy vehicles, there would be potential for higher impacts than reported here. This will be managed via the Traffic Management Plan to avoid this scenario occurring.
Haul road traffic has been assumed to pass at the nearest point on the works to each receptor and has been assessed based on the highest pass-by level at this point.	It is expected that haul routes will largely be along the perimeter of the works and therefore this is likely to be a fair assumption, however, if a haul road were to be implemented closer to a property, then impacts could be higher than predicted. In reality the assessment has assumed that a number of vehicles are operating at once in one location which produces a worst-case assessment.
Normal working hours have been assumed to be ten hours per day. When night-working is required it is likely that this would include 24 hour working, however, the assessment has been made on the most sensitive night-time period between 23:00 and 08:00.	For a small increase in daytime hours up to twelve hours (07:00 to 19:00) it is unlikely that there would be additional significant effects, as the assessment undertaken uses reasonable worst-case percentage on-times for construction plant. If works extended into the more sensitive evening period, there would be an increased risk of significant effects. The EMP (provided with DCO application) will be used to control the permitted hours of normal working to avoid this situation. For the times when night-working is required, as included in this assessment, the inclusion of the evening or weekend daytime period, would not give rise to additional significant effects.

- 11.5.4 The effects of noise and vibration on ecological receptors have not been included in this chapter. However, the noise impact data from this assessment has been used in Chapter 8 (Biodiversity). This is a requirement of the NPSNN. Heritage conservation assets have been included in the assessment of noise impacts, and noise is also considered as part of a wider assessment of the proposed scheme impacts on these receptors in Chapter 6 (Cultural Heritage).

#### Uncertainty

- 11.5.5 For the PEI report, the traffic models are based on an opening year of 2024 and 2039 (15 years after opening). It is noted that the modelled years do not coincide

with the revised opening and design year for the proposed scheme. It is considered that these do not materially affect the results of the assessments undertaken.

- 11.5.6 The assessment has been undertaken assuming that construction works on site will start in 2023. The baseline noise condition has been based on the expected scheme opening year traffic for 2024 (see paragraph 11.5.5) and has been cross referenced against a noise survey undertaken in 2019. Given the high flows on the A417 in this area, and the absence of other noise sources, it is unlikely that the baseline condition in 2023 would differ substantially enough to alter the assessment presented herein.
- 11.5.7 The construction assessment is necessarily based on preliminary assumptions at this stage in the design and tends to overstate the likely impacts and effects. For receptors in very close proximity to the works, small differences in the assumed distance from the works, could cause changes of 1dB or more in the predictions. Due to such properties already being predicted to experience significant effects, these small differences are unlikely to change the overall conclusions of the assessment.
- 11.5.8 As already stated, the temporal thresholds have considered a worst-case situation for this assessment and therefore it is unlikely that impacts would worsen as a result in a programme change, however, if the rate of progression of some activities were to be much slower than assumed, then temporal thresholds may be met for more activities. It is very unlikely that this would affect any receptors that are not currently predicted to experience a significant effect from one or more activities.
- 11.5.9 An increase in duration and/or frequency of night-time working could give rise to additional significant effects at more distant properties due to the lower noise thresholds for impact at night.

### **Operation**

- 11.5.10 Road traffic flows and speeds used in the assessment were provided by the project traffic specialists for all the assessment scenarios. The traffic forecasting is in line with the current guidance.
- 11.5.11 Lower noise surface would be laid on all new and altered roads in the proposed scheme. It is assumed that, lower noise surface is already laid in Do-Minimum baseline year (2024).
- 11.5.12 The proposed scheme design is landscape-led to reduce visual and landscape impacts to the special character of the Cotswolds AONB. Landscape earthworks proposed for the scheme are assumed as an integrated part of the permanent scheme - refer to Chapter 7 (Landscape and Visual). These features, integrated with earthworks specifically included for noise mitigation, would reduce wayside noise. The locations alongside the scheme are indicated in Figure 11-2.
- 11.5.13 Noise insulation would be offered if and where future noise levels exceed the noise level trigger value of  $68\text{dB}_{\text{pA}10,18\text{hr}}(\text{façade})$  and the other requirements referred to in the Noise Insulation Regulations 1975 (as amended) (NIR). Confirmation of qualification for noise insulation would be made by the responsible authority before the proposed scheme comes into operation, based on built information in accordance with the NIR.

## 11.6 Study area

11.6.1 The determination of the assessment study area (as shown in Figure 11.1) has been based on DMRB LA 111; these requirements are described below.

### Construction

11.6.2 For construction noise and vibration, the study area shall include all noise sensitive receptors:

- that are potentially affected by construction noise or vibration;
- in areas where there is a reasonable stakeholder expectation that a construction noise or vibration assessment will be undertaken.

### Noise

11.6.3 LA 111 notes that a study area of 300m from the closest construction activity is normally sufficient to encompass noise sensitive receptors, although variations in the study area can be defined for individual projects. BS 5228 (referenced within LA 111) notes that the prediction results should be treated with caution at distances greater than this (as the prediction results may be less reliable).

11.6.4 A diversion route study area shall be defined where a project requires full carriageway closures during the night (23:00-07:00) to enable construction works to take place. This shall include a 25m width from the kerb line of the diversion route.

11.6.5 A construction traffic study area shall be defined to include a 50m width from the kerb line of public roads with the potential for an increase in BNL<sup>xii</sup> of one dB(A) or more as a result of the addition of construction traffic to existing traffic levels.

### Vibration

11.6.6 LA 111 notes that a study area of 100m from the closest construction activity with the potential to generate vibration is normally sufficient to encompass vibration sensitive receptors. However, variations in the study area can be defined for individual projects.

### Operation

11.6.7 The assessment procedure requires that an operational noise<sup>xiii</sup> impact study is defined to include:

- noise sensitive receptors that are potentially affected by operational noise changes generated by the project, either on the route of the project or other roads not physically changed by the project; and
- noise sensitive receptors in areas where there is a reasonable stakeholder expectation that noise assessment is undertaken<sup>xiv</sup>.

<sup>xii</sup> BNL: the 'Basic Noise Level' at a reference distance of 10m from the nearside carriageway edge, as defined in CRTN.

<sup>xiii</sup> LA 111 Paragraph 1.4 notes that: 'Operational vibration is scoped out of the assessment methodology as a maintained road surface will be free of irregularities as part of project design and under general maintenance, so operational vibration will not have the potential to lead to significant adverse effects.'

<sup>xiv</sup> Based on the comments received from stakeholders during the 2019 public consultation, the areas of Cowley and Coberley have been fully included in the noise study area and assessment.

- 11.6.8 For most projects the following areas are suitable, but LA 111 notes that the assessor can reduce or extend this such that it is proportionate to the risk of likely significant effects:
- the area within 600m of new road links or road links physically changed or bypassed by the project;
  - the area within 50m of other road links with potential to experience a short term BNL change of more than 1.0dB(A) as a result of the project.

## 11.7 Baseline conditions

### Current baseline

- 11.7.1 Noise or vibration sensitive locations have been identified for inclusion in the assessment across the study area (see Figure 11.1). Surveys have been carried out at sufficient locations to represent noise sensitive areas alongside the proposed scheme. The noise survey was carried out in accordance with the 'Shortened measurement procedure', described in paragraph 43 of CRTN (survey procedures and locations are described in Appendix 11.2). The baseline survey locations are shown in Figure 11.1.
- 11.7.2 It is assumed that local noise conditions would not change substantively between the survey period and the commencement of proposed works.
- 11.7.3 The baseline noise conditions (i.e. Do-Minimum) for the operational traffic assessment have been determined by the CRTN noise prediction model for a forecast traffic scenario of 2024. This has provided a detailed coverage of noise levels across the entire study area.
- 11.7.4 LA 111 requires that noise level calculations are carried out to compare noise changes between the Do-Minimum and Do-Something scenarios to assess the impact of the proposed scheme.
- 11.7.5 Figure 11.1 shows the locations of the noise receptors (dwellings and other noise sensitive properties) and their proximity to the existing A417 and the surrounding roads. The predicted traffic noise level contours for the baseline year (i.e. Do-Minimum 2024 for the noise assessment) are also shown so that the relative baseline noise exposures of the different sensitive receptors can be seen. Noise Important Areas<sup>32</sup> (NIA) – see Figure 11.1, are shown to identify dwellings in areas of relatively high noise exposure recognised by Defra.
- 11.7.6 The following sections summarise the noise sensitive receptor locations across the proposed scheme area, the locations are described using the chainage references for the scheme alignment. The following sections should be read with reference to Figure 11.1.

### Bentham to Air Balloon roundabout – 0+000 to 2+100

- 11.7.1 At the western extent of the proposed scheme corridor, the improved highway would follow the existing alignment along the Brockworth bypass. The study area for the noise assessment extends beyond the western end of the scheme to include dwellings in Witcombe to the south-west and a recently established housing development to the north-west near to the Bentham Country Club. There are also scattered dwellings which lie either side of the highway within approximately 50-150m.

- 11.7.2 Moving east from chainage 1+500 to 2+100, the scheme alignment ascends towards Air Balloon roundabout. Crickley Hill Country Park lies approximately 700m to the west of the Air balloon roundabout where the hillside rises steeply from the highway, to a height of approximately 60m above the existing A417. The Cotswold Way runs on the top of this escarpment and approximately parallel with the A417 highway. The peak of Crickley Hill is approximately in line with 1+500. At this point the Cotswold Way is located approximately 160m to the north-west of the A417. Figure 11.1 shows that existing noise levels are in the range 62.5-65.0dB  $L_{Aeq,16hr}$  along this section of the footpath. As the Cotswold Way continues toward Air Balloon roundabout, it descends progressively lower and closer to the proposed scheme. The boundary of the Country Park is close to the existing highway alignment. At 2+000 the Cotswold Way is around 10m from the existing highway. Figure 11.1 shows that existing noise levels are in the range 72.5-75.0dB  $L_{Aeq,16hr}$  along this section of the footpath. The Park is used by the public as an outdoor amenity destination; there are popular footpaths through the woodland and grassland areas. There are picnics areas and there is a visitor centre. The Park also has SSSI<sup>xv</sup> and scheduled monument designations (Crickley Hill Camp). To the south of the highway the ground also rises steeply on approach to the roundabout with a residential property approximately 100m from the highway.
- 11.7.3 There are four Noise Important Areas identified on this section at residential locations close to the highway, as shown on Figure 11.1 (NIAs 3906, 3907, 3908 and 13915).

#### **Air Balloon roundabout to Cowley junction– existing alignment**

- 11.7.4 From the Air Balloon roundabout, the existing A417 runs south to the east side of Birdlip (approx. 250m away) with the Cotswold Way footpath running along the top of the escarpment with the Barrow Wake viewpoint beside the road. Just to the east of the A417 on the Gloucestershire Way is Emma's Grove (a scheduled monument consisting of a group of three round barrows, known collectively as Emma's Grove). There are scattered dwellings at various locations within approximately 50-150m from the highway between the Air Balloon and Cowley junction roundabouts. The Peak, a Neolithic enclosure and heritage asset (although not a designated SM), is north-west of Birdlip approximately 900m west of the existing A417. Stockwell is approximately 400m north-east of the existing A417 with a network of footpaths on either side of the highway.
- 11.7.5 There is one Noise Important Areas identified on this section at a residential location approximately 350m north-west of the Cowley junction, as shown on Figure 11.1 (NIA 3905).

#### **Air Balloon roundabout to Cowley junction– proposed re-alignment – 2+100 to 5+760**

- 11.7.6 The proposed scheme corridor would continue east of the Air Balloon roundabout (2+150), turning south-east between Birdlip Radio Station and Rushwood Kennels and Cattery (3+000). There are a few dwellings within 200m of the proposed scheme on this section. The Gloucestershire Way footpath is presently aligned north-west to south-east in this locality and would be crossed by the proposed scheme corridor (2+750). Currently, this point on the footpath is

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<sup>xv</sup> SSSI ('Site of Special Scientific Interest').

approximately 700m from the existing A417 alignment, hence noise levels are between 40.0 and 45.0dB  $L_{Aeq,16hr}$  for much of this section. Moving south-east, the proposed scheme corridor passes approximately 300m north of Stockwell through open grassland with no dwellings within several hundred metres towards the point where it would reconnect with the existing A417 at Cowley junction. Existing noise levels around the various footpaths in this area range from 42.5 to 50.0dB  $L_{Aeq,16hr}$  between 3+000 and 5+000, and gradually increasing to 55dB  $L_{Aeq,16hr}$  at the closest footpath to Cowley junction.

- 11.7.7 There is a Noise Important Area identified on this section of the study area at residential locations close to the highway on the A436, north-east of the scheme, as shown on Figure 11.1 (NIA 13196) – Laurel Cottage (The Grove and Crendon House are close by but are not within the NIA area).

### **Future baseline**

- 11.7.8 As set out in Chapter 4, the ‘Do-Minimum’ and ‘Do-Something’ scenarios have been set out, with the ‘Do-Minimum’ scenario representing the future baseline with minimal interventions and without new infrastructure. Potential changes to noise and vibration receptors in the future are not considered sufficient to affect the assessment, i.e. there would be no large changes to topography or large noise-screening structures. Receptor groups are unlikely to be different to those identified in the baseline text above. The exception to this is committed residential development at the west end of the study area, north and south of the Brockworth bypass which has been included in the noise model to represent the future baseline scenario. In all other respects, the future baseline would remain the same as set out in above.

## **11.8 Potential impacts**

### **Construction impacts**

- 11.8.1 The construction works would include a major area of earthworks cut and fill in the northern part of the proposed scheme which is likely to be the area of most prolonged works. There are three areas of proposed junction works including a grade-separated junction at Shab Hill. Away from the major earthworks and junctions, the new or improved carriageway works would progress more rapidly along the scheme, and hence would be alongside any one receptor location for a shorter period.
- 11.8.2 Noise impacts and effects are most likely around the area of major earthworks. Generally, only where dwellings are very close to the works, is there likely to be potential for vibration impacts depending on the particular plant machinery used.

### **Operation impacts**

- 11.8.3 Operational noise adverse impacts would largely be as a result of the proposed scheme road alignment changes, rather than as a result of future traffic growth associated with the proposed A417 scheme. The greatest adverse impacts would occur where the scheme would be much closer to nearby noise sensitive receptors than the existing highway. Where the distance between the highway and receptor is halved (or even closer), there is the potential for significant adverse effects. Minor changes in alignment, particularly where the receptors are some distance from the existing highway, would be less likely to result in impacts as the proportionate change in distance would be small. Conversely, there are



locations where the proposed scheme would be substantially further from receptors such that there is the potential for significant beneficial effects.

## 11.9 Design, mitigation and enhancement measures

### Construction mitigation

- 11.9.1 The construction noise and vibration assessments assume that the works would be undertaken following the principles and processes to be set out in the Environmental Management Plan (EMP) which will be produced and submitted as part of the DCO application. The EMP will include a commitment for a Noise and Vibration Management Plan (NVMP) to be prepared.
- 11.9.2 In advance of construction for the consented project. This will include the requirement to undertake noise and vibration monitoring to ensure compliance with, and early warning of exceedances of agreed threshold levels.
- 11.9.3 Best Practicable Means (BPM) is assumed as incorporated mitigation to control construction noise in the form of low noise emission plant and processes (as specified in BS 5228 Annex B - Noise sources, remedies and their effectiveness).
- 11.9.4 BPM would include noise and vibration control - for example:
- the selection of quiet and low vibration equipment;
  - review of construction programme and methodology to consider quieter methods (including non-vibratory compaction plant, where required);
  - sensitive location of equipment on site, control of working hours, to be set out and controlled through a Section 61 agreement, (to be described in EMP submitted with the DCO application)<sup>xvi</sup>;
  - the provision of acoustic enclosures and the use of less intrusive alarms, such as broadband vehicle reversing warnings;
  - screening where practicable - for example local screening of equipment, perimeter hoarding or the use of temporary stockpiles;
  - training of site personnel; and
  - provision of information to the public.
- 11.9.5 If situations arise where, despite the implementation of BPM, the noise exposure exceeds the criteria that will be defined in the EMP, the main contractors may offer noise insulation to affected properties, or ultimately, temporary re-housing; however, it is not anticipated that the latter will be required for this scheme.

### Operation mitigation

#### Essential mitigation

- 11.9.6 The alignment of the proposed scheme (horizontal and vertical) has been considered as part of the design factors to minimise noise impacts. In addition, the essential noise mitigation described in Table 11-17 is included solely for noise screening (earth bunds, Cotswold Walls and environmental barriers). These were integrated into the landscape and visual mitigation design and were informed by comments from the stakeholder consultation exercise.

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<sup>xvi</sup> Further mitigation detail will be developed as the proposed scheme design progresses



11.9.7 To ensure that additional mitigation is practicable and sustainable, the provision has been subject to the following tests:

- stakeholder engagement and consultation responses;
- engineering practicability;
- consideration of noise benefit compared to cost of the mitigation; and
- other environmental effects potentially caused by the mitigation (for example landscape or visual effects).

**Table 11-17 Incorporated noise mitigation measures for operation of the scheme**

Location (See Figure 11.2)	Indicative chainage	Indicative screening length (m)	Total screening height relative to road level (m)	Description (heights relative to road including any cutting depth)
Immediately north of Shab Hill junction (along northbound carriageway)	3+050 to 2+800	250	7.2 to 8.2	Variable height (6m to 7m) earth bund with 1.2m Stone Wall
Along the B4070, from Shab Hill Farm access road to Shab Hill junction underpass	-	225	1.2	1.2m Stone Wall
Immediately north of Shab Hill junction (along southbound carriageway)	2+920 to 3+100	180	5 to 6	Variable height (5m to 6m) earth bund only
Alongside northbound carriageway through Shab Hill junction	3+210 to 2+985	225	2.0	2m Stone Wall
B4070 to Shab Hill junction	-	230	1.2	1.2m Stone Wall
Cowley Lane overbridge to Shab Hill junction (along northbound carriageway)	4+020 to 3+290	730	4.2 to 10.2	Variable height (3m to 9m) earth bund with 1.2m Stone Wall
Shab Hill junction – East Dumbbell roundabout to southbound onslip	-	120	4.2	3m earth bund with 1.2m Stone Wall
Shab Hill junction to Cowley Lane overbridge (along southbound carriageway)	3+380 to 4+020	640	3.2 to 6.2	Variable height (2m to 5m) earth bund with 1.2m Stone Wall
Cowley bridlepath overbridge to Cowley Lane overbridge (along northbound carriageway)	4+685 to 4+100	585	4.2 to 10.2	Variable height (3m to 9m) earth bund with 1.2m Stone Wall
Cowley Lane overbridge to Cowley bridlepath overbridge (along southbound carriageway)	4+050 to 4+720	670	3.2 to 9.2	Variable height (2m to 8m) earth bund with 1.2m Stone Wall
Cowley Lane bridlepath to Cowley junction (along southbound carriageway)	4+775 to 5+070	295	3.2	Variable height (2m to 8m) earth bund with 1.2m Stone Wall
Cowley junction eastern loop	5+200 to 5+350 (eastern loop)	160	4.2 to 6.2	Variable height (3m to 5m) earth bund with 1.2m Stone Wall
NIA 3906 (Crickley Cottage) (along eastbound carriageway)	0+518 to 0+598	80	3.5	3.5m Vertical Noise Barrier (Absorptive)

Location (See Figure 11.2)	Indicative chainage	Indicative screening length (m)	Total screening height relative to road level (m)	Description (heights relative to road including any cutting depth)
NIA 3907 (Fernbank) (along eastbound carriageway)	1+375 to 1+475	100	3.5	3.5m Vertical Noise Barrier (Reflective)

11.9.8 The EMP which will be produced and submitted as part of the DCO application will ensure implementation of operational noise controls.

### Enhancement

11.9.9 Further to the avoidance and mitigation measures integrated along the length of the proposed scheme to reduce adverse noise effects, consideration will be given to developing enhancements during detailed design of the scheme. For example, when more design detail can be confirmed, there may be opportunities to extend environmental screening (e.g. Cotswold Walls) in certain areas if it can be shown that this would provide beneficial enhancements with regard to noise. This would not be likely to apply to extents of noise screening described in Table 11-17 which were identified specifically as optimal noise mitigation measures, and no further noise mitigation is considered sustainable.

11.9.10 Any such enhancement would have to be shown to be sustainable based on the criteria described in paragraph 11.9.7, particularly the landscape and visual impacts of any such measures.

11.9.11 Noise mitigation will result in enhancements at a number of NIAs (locations described in Table 11-17). This responds to Aim 3 as set out in in the 'England National Application Annex to LA 111' to 'improve the noise environment'; in this case in areas worst affected by existing high noise levels.

## 11.10 Assessment of effects

11.10.1 The assessment approach for construction and operation considers a range of receptors and effects. The following assessment sections are divided as follows:

- Residential receptors: direct and indirect effects exceeding the SOAEL;
- Residential receptors: direct and indirect effects between the LOAEL and SOAEL; and
- Non-residential receptors: direct and indirect effects.

### Construction effects

#### Noise

11.10.2 Construction noise effects have been calculated based on reasonable worst-case assumptions taking into account the main construction activities expected and the likely durations and on-times of individual plant items. At the time of the assessment, the available information about the programme and construction methods was used, as well as a series of assumptions as summarised in section 11.5, Table 11-16 and Appendix 11.3.

- 11.10.3 The majority of activities are assumed to be linear (i.e. taking place along the proposed scheme in a sequential manner) e.g. site preparation, cuttings, drainage and pavement. The activities associated with the structures stage, including A436 roundabout, Shab Hill junction, Cowley Lane overbridge, Stockwell Farm overbridge, Cowley junction and footbridges for Cotswold Way Crossing and Gloucestershire Way crossing will take place in particular parts of the scheme and so affect only some of the receptors.
- 11.10.4 A material storage compound will be sited to the west of the main cutting at approximately chainage 2+500, which will house plant for the processing of spoil produced by the excavation works. It is proposed that the topsoil and any subsoil removed to level this storage compound would then be used to construct a 'temporary' earth bund around the plant to provide effective noise screening. There will be a significant number of dumper truck movements associated with 'incoming' and 'outgoing' materials at this site compound. All of these stages and their associated processes, have been considered within this assessment, and are described in 11.10.11
- 11.10.5 There will also be two main site compounds and a number of other satellite compounds mainly housing welfare facilities and offices. The main site compounds will be adjacent to Cowley junction and at the northern extent of the proposed scheme adjacent to Bentham Lane overbridge. There is likely to be some noise from construction plant within the compounds, for example, from mobile plant starting up and leaving the compound in the mornings and then returning in the evenings. However, these events will only occur for a short duration during the start-up and shutdown periods. There will also be noise generated by material delivery vehicles to the site compounds. Given the locations of the compounds, in relation to the main works, and the existing high levels of road traffic noise from the A417, it is unlikely that noise from the site compounds will be significant at any receptors.
- 11.10.6 Some sections of the existing A417 would be converted into a route for walkers, cyclists and equestrians (new PRoW). No details about the exact works or programme were available at the time of this assessment, however, it is likely that any works to remove the pavement would be undertaken using a road planer. It has not yet been established exactly what material and finish will be used to re-instate this as a new PRoW but it is unlikely to involve noisier works than the road planing discussed above. Whilst the road planing is a noisy activity, works would be expected to progress along the route by at least 75m per day. This rate of progress would quickly pass by the closest residential properties to the nearest section of the old carriageway (Rose Cottage, The Old Pyke House, Birdlip View, Welwyn, Hillcot, The Cottage Catchbar, Purdey House, Pheasants Keep, Hawcote House and Highclere). The worst case predicted noise level would be approximately 68dB<sub>L<sub>Aeq</sub></sub>, lasting for several days at most, and would then reduce quickly as the works progressed further away. This work would not fulfil the duration criteria for significant effects described in the methodology (paragraph 11.4.37). This work would therefore be unlikely to give rise to significant effects at individual receptors.
- 11.10.7 Night-time activities will be kept to the bare minimum required to complete activities for which road closures are essential. It is currently expected that night road closures will only be required for installing and removing traffic management measures at tie-in junctions. The total number of working nights is currently expected to be fewer than 30 throughout the 48-month construction period. Works

undertaken during these nights would be divided between Crickley Hill, Air Balloon roundabout, Shab Hill junction and Cowley junction.

- 11.10.8 The construction stages predicted to result in the highest noise levels during the daytime are generally cutting and/or earthworks, however, several activities are predicted to give rise to significant effects (combination of impact level and duration) at a number of receptors including site clearance, drainage and structures. At some receptors, significant effects during the daytime are also predicted to arise from topsoil stripping, subbase preparation and pavement surfacing activities. The area of earthworks between approximate chainages 0+800 and 2+800 would require the most intensive activity over the longest duration.
- 11.10.9 During the night-time, due to the limited number of nights of effect at any individual receptor, significant effects are unlikely to occur.
- 11.10.10 In the following assessment sections the impacts and likely significant effects during daytime construction works are considered first, followed by night-time.
- 11.10.11 For the purposes of the daytime assessment, the principle construction activities have been considered and divided into the following 14 stages associated with the overall work:
- site clearance, tree and vegetation removal;
  - boundary fence;
  - topsoil strip;
  - cutting;
  - drainage;
  - subbase;
  - surface water channel;
  - pavement and surfacing;
  - earthworks (minor);
  - earthworks (major);
  - structures;
  - stone crushing;
  - Shab Hill junction piling (included in structures); and
  - road planing (removal of old surface).
- 11.10.12 Table 11-18 identifies the daytime LOAEL and SOAEL thresholds as set out in DMRB LA 111. The LOAEL is determined from the predicted baseline noise levels and the SOAEL is based on the BS 5228 ABC method (referenced within LA 111) as described in paragraph 11.4.30. The traffic noise prediction model has been used to estimate the baseline ambient façade noise levels at each construction receptor location. The receptor locations represent noise sensitive locations closest to the proposed works that would be most affected. The appropriate ABC method assessment category (and therefore the SOAEL) for each location has been determined from the predicted ambient noise level at the façade. This has been taken from the baseline noise level prediction for 2024

(opening year<sup>xvii</sup>) and would be expected to be the same in the pre-construction scenario in 2023.

- 11.10.13 Table 11-18 also presents predicted monthly construction noise levels at each receptor (see Figure 11.1 for receptor locations for the construction assessment). These have been predicted using the methodology described in Paragraph 11.4.3. Where the cell text is in grey italic font, the range of predicted monthly construction noise levels is below the predicted baseline noise level and therefore below the LOAEL for construction noise (see criterion in Table 11-3). Where the text is in bold font, the highest predicted value exceeds the ABC potential significance threshold and therefore also exceeds the SOAEL for construction noise (Table 11-4).
- 11.10.14 LA 111 requires that significance be determined based on whether a moderate or major impact is likely to endure for ten or more days in any consecutive 15, or 40 days in a consecutive six-month period at any individual receptor. No activities have been assumed to last for less than one month and the noise levels for the worst case (i.e. the point when works are closest to the receptor) and the 'two weeks before and after' scenarios have been summed logarithmically. This tends towards the higher noise level, hence it is considered that what is presented below is a worst-case when compared to the LA 111 temporal thresholds.

**Table 11-18 Daytime construction noise assessment at residential and non-residential locations**

Location (see Figure 11.1)	LOAEL (baseline noise level) <sup>1</sup> dBL <sub>Aeq,12hr</sub>	SOAEL (ABC threshold) <sup>1</sup> dBL <sub>Aeq, 12hr</sub>	Range of predicted monthly daytime construction noise levels <sup>1,2</sup> dBL <sub>Aeq, 10hr</sub>
R1 Crendon House	64	70	<30 - 60
R2 Fernbank	73	75	54 - <b>83</b>
R3 Crickley Ridge	62	65	46 - <b>79</b>
R4 Air Balloon Cottages	75	75	55 - <b>82</b>
R5 Birdlip Radio Station	46	65	59 - <b>83</b>
R6 Rushwood Kennels and Gloucestershire Way	46	65	56 - <b>79</b>
R7 Stockwell Farm Barn	45	65	30 - 58
R8 Chestnut Cottage	45	65	<30 - 59
R9 Crickley Hill Visitor Centre	54	65	30 - 62
R10 Four Winds	61	65	36 - <b>68</b>
R11 Keepers Cottages	43	65	<30 - 49
R12 Shab Hill Farm	44	65	47 - <b>71</b>
R13 Castle Hill Cottage	75	75	34 - 69
R14 Nothill, Cowley	38	65	<30 - 53
R15 Crickley Court Cottage	69	75	54 - 72
R16 Emma's Grove	62	65	43 - <b>75</b>

<sup>xvii</sup> It is noted that the modelled years do not coincide with the revised opening and design year for the proposed scheme. It is considered that these do not materially affect the results of the assessments undertaken.

Location (see Figure 11.1)	LOAEL (baseline noise level) <sup>1</sup> dBL <sub>Aeq,12hr</sub>	SOAEL (ABC threshold) <sup>1</sup> dBL <sub>Aeq, 12hr</sub>	Range of predicted monthly daytime construction noise levels <sup>1,2</sup> dBL <sub>Aeq, 10hr</sub>
R17 Holly Brae	66	70	47 - 66

<sup>1</sup> Noise level includes correction for façade acoustic reflection (i.e. noise level at 1m from façade).

<sup>2</sup> Where the cell text is grey/italic, the range of predicted noise levels are below the LOAEL. Where the text is in bold font, the highest predicted value exceeds the ABC potential significance threshold and therefore exceeds the SOAEL for construction noise (Table 11-3)

### Residential receptors: effects exceeding the SOAEL during the day

11.10.15 The ABC potential significance threshold and therefore the SOAEL would be exceeded during some months at the following construction assessment receptors. Nearby receptors which are expected to experience similar noise levels to the assessment receptors are shown in brackets:

- R2 Fernbank (also Grove Lodge, Haroldstone Lodge, Halfacres, The Willows (2 properties) and The Spinney);
- R3 Crickley Ridge;
- R4 Air Balloon Cottages (numbers 1 and 2);
- R6 Rushwood Kennels;
- R10 Four Winds (also Barrow Wake House); and
- R12 Shab Hill Farm (also Shab Hill Barn).

11.10.16 The following paragraphs describe the impacts at receptors, starting from the northern end of the proposed scheme where it links into A417 Brockworth bypass and moving to the southern end where it links in with the A417 south of Cowley. Receptors predicted to experience major impacts are discussed first followed by moderate impacts. As construction is a new noise source introduced into the environment, all impacts are adverse.

#### *Major Impacts*

11.10.17 Receptor R2 Fernbank (see Figure 11.1) has a predicted construction noise level up to 8dB(A) above its significant effect threshold (SOAEL) of 75dBL<sub>Aeq,day</sub>, with the worst-case impacts arising from the major earthworks activities being undertaken over a number of weeks. Other activities exceeding SOAEL are site clearance and a combination of drainage and subbase works. Although a number of other receptors are grouped with Fernbank for the purposes of this assessment, it is unlikely that they will experience the same level of impact due to being set back at least twice the distance from the works. These receptors are discussed in the appropriate sections below. The impact at Fernbank is assessed as major (see magnitude of impact criteria in Table 11-6).

11.10.18 Receptor R3 Crickley Ridge has a predicted construction noise level of up to 14dB(A) above its significant effect threshold of 65dBL<sub>Aeq,day</sub>. The worst-case impacts at this receptor are predicted to arise from cutting activities which are likely to affect the receptor for a number of months. Structures work is also predicted to exceed significance thresholds for a period of one month or more. This is assessed as a major impact.

11.10.19 Receptor R4 representing Nos.1 and 2 Air Balloon Cottages, is situated at approximately 15m from the new section of the Cold Slad connection to the proposed A436 roundabout and approximately 50m from the A417 mainline

works. Its significance threshold of  $75\text{dB}_{\text{L}_{\text{Aeq,day}}}$  is predicted to be exceeded by  $7\text{dB(A)}$  for a period of one month or more, with the highest impacts arising from the mainline cutting activities. Other exceedances will arise from site clearance, drainage, subbase, pavement and surfacing works. High noise levels arising from activities being undertaken on the Cold Slad connection road are likely to be of shorter duration than those being undertaken on the A417 mainline. This is assessed as a major impact at Air Balloon Cottages.

- 11.10.20 The residential receptor represented by R6 Rushwood Kennels has a threshold for significant effects of  $65\text{dB}_{\text{L}_{\text{Aeq,day}}}$ . The highest impacts at R6 are predicted to exceed the threshold by  $14\text{dB(A)}$  and arise predominantly due to the activities for the construction of the new A436 alignment and new access road together with concurrent cutting work further north and the adjacent construction of Shab Hill junction. Other activities exceeding SOAEL include site clearance, topsoil stripping, drainage, subbase preparation, surface water channel construction and pavement works. This is assessed as a major impact at this receptor.
- 11.10.21 Receptor R12, Shab Hill Farm (farm and dwelling) is predicted to experience noise levels up to  $6\text{dB(A)}$  above its significance threshold of  $65\text{dB}_{\text{L}_{\text{Aeq,day}}}$  for a period lasting a month or more. The highest impact is predicted to occur during the topsoil strip on the proposed B7070 link road. Other activities giving rise to impacts in excess of SOAEL are drainage, surface water channel and subbase works being undertaken concurrently, and earthworks and structures work to construct Shab Hill junction. This is assessed as a major impact at this receptor.
- 11.10.22 The above impacts are assessed as direct temporary likely significant observed adverse effects.

#### Moderate Impacts

- 11.10.23 Halfacres, The Willows, The Spinney, Haroldstone Lodge and Grove Lodge represented by Receptor R2 Fernbank but located further back from the works, are likely to experience noise levels which exceed the SOAEL ( $75\text{dB}_{\text{L}_{\text{Aeq,day}}}$ ) by less than  $5\text{dB}$  and therefore these are assessed as moderate impacts at these receptors.
- 11.10.24 Four Winds and Barrow Wake House, represented by Receptor R10, are some distance from the nearest point of the construction works but have a wide view of the works and therefore will receive contributions from multiple activities simultaneously. The predicted construction noise level at this receptor is  $3\text{dB(A)}$  above SOAEL ( $65\text{dB}_{\text{L}_{\text{Aeq,day}}}$ ) for a period of one month or more, with the highest impacts arising from cutting activities. This is assessed as a moderate impact at these receptors.
- 11.10.25 The predicted noise levels are above the SOAEL in some months for all receptors described above, which is an indication of a temporary significant observed adverse effect. The rate of progression of the works, and therefore the duration of noise exposure, have been considered within the assessment.

#### Residential receptors: direct effects between LOAEL and SOAEL

- 11.10.26 In locations with lower predicted construction noise levels (between the LOAEL and SOAEL), these noise changes may be considered by the local community as an adverse effect on the acoustic character of the area and hence be perceived as a change in the quality of life.

- 11.10.27 The construction noise levels are predicted to exceed the LOAEL (existing ambient noise level) in some months, but not exceed the SOAEL at the following receptors:
- R7 Stockwell Farm Barn and Cottages (8 dwellings)
  - R8 Chestnut Cottage (also Cottage Barn, Hill Barn and Cuckoopen Barn Farm);
  - R11 Keepers Cottages (2 dwellings); and
  - R14 Nothill, (representing the village of Cowley)
  - R15 Crickley Court Cottage; and
  - R17 Holly Brae
- 11.10.28 The construction noise levels at these receptors are below the SOAEL and therefore are assessed as minor impacts and not significant based on the LA 111 methodology.

Residential receptors: indirect effects

- 11.10.29 There are no indirect effects resulting from construction activities on the works sites. However, there is the potential for indirect effects as a result of diverted traffic during night-time road closures and this is considered starting at paragraph 11.10.45.

Non-residential receptors: direct effects above SOAEL

- 11.10.30 Receptor R16 representing Emma's Grove (scheduled monument) is assessed as a major noise impact affecting the scheduled monument and taking into account the likely duration of the major impact, it is assessed as a temporary likely significant observed adverse effect using the LA 111 assessment criterion.
- 11.10.31 Receptor R5 Birdlip Radio Station is located some 100m from the mainline works but is only 25m from the proposed Shab Hill junction slip roads. The highest impacts would occur during the earthworks preparation for the construction of Shab Hill junction when noise levels would exceed the significance threshold by 18dB(A). Other activities predicted to produce noise levels exceeding the threshold are site clearance, cutting, drainage, subbase, surface water channel, pavement and structures. This is assessed as a major impact at this receptor. It is understood that office accommodation is likely to be the most sensitive use (i.e. not acoustic studio uses). Given the noise level of the construction works and the estimated noise ingress, the likely effect at this receptor is assessed as a direct temporary likely significant observed adverse effect.
- 11.10.32 Receptor R6 is discussed in detail in paragraph 11.10.20 under residential receptors. It also represents Rushwood Kennels and Cattery and the closest point on the Gloucestershire Way which are discussed below.
- 11.10.33 Rushwood Kennels and Cattery would be subject to construction noise affecting employees and other users of the facility for more than one month. This is assessed as a direct temporary likely significant observed adverse effect.
- 11.10.34 Receptor R6 represents the closest point on the Gloucestershire Way (link ACY3<sup>xviii</sup> as shown on Figure 11.1) at approximately 30m from the works on the proposed local access road and 85m from the proposed A436 works. Up to

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<sup>xviii</sup> GCC PRoW reference number.



around 500m away from the construction works, the impacts would be above SOAEL and therefore a major or moderate impact is determined for a 500m section of the Gloucestershire Way in link ACY3, reducing to a minor impact beyond this. The major/moderate impact area of the footpath is assessed as being a direct temporary likely significant observed adverse effect on the PRoW for link ACY3.

- 11.10.35 Similar temporary noise effects are likely to occur for other sections of footpath within approximately 500m of major excavation works. This would not apply at these distances for locations currently dominated by noise from major roads.

Non-residential receptors: direct effects between LOAEL and SOAEL

- 11.10.36 Receptor R9, Crickley Hill Visitor Centre, is some 340m from the works at the nearest point. The predicted highest monthly construction noise level is 62dB<sub>L<sub>Aeq, day</sub></sub> (free-field), as a result of cutting activities. This is below the SOAEL but above the LOAEL for this receptor during some months. LOAEL exceedances are also predicted for a month or more due to earthworks activities on Crickley Hill and structures phases. This is assessed as a minor impact at this receptor and is not significant.

Non-residential receptors: indirect effects

- 11.10.37 There are no indirect effects associated with the construction activities.

Construction traffic noise

- 11.10.38 During the most intensive construction period, it is expected that 290 trucks per day will visit the site to transport material to and from site. These trucks will access the site via the A417 to the north and south. Existing flows on these sections of road are around 35000 vehicles per day including approximately 3500 heavy vehicles. The addition of 580 two-way trips onto the existing road network will therefore result in a negligible increase (<1dB(A)) in overall noise level and hence noise on haul routes away from site is assessed as being not significant. The use of haul routes on the site is covered within the assessment described above.

Night-time noise

- 11.10.39 For the purposes of the night-time noise assessment, the following construction activities have been considered:
- traffic management works at A417 Crickley Hill;
  - traffic management works at Air Balloon and A436 roundabout;
  - traffic management works at Shab Hill junction; and
  - traffic management works at Cowley junction.
- 11.10.40 Table 11-19 identifies the night-time LOAEL and SOAEL thresholds as set out in DMRB LA 111. Only residential facilities are considered for the night-time assessment.

**Table 11-19 Night-time construction noise assessment at residential locations**

Location (see Figure 11.1)	LOAEL (baseline noise level) <sup>1</sup> dBL <sub>Aeq,8hr</sub>	SOAEL (ABC threshold) <sup>1,3</sup> dBL <sub>Aeq,8hr</sub>	Range of predicted night-time construction noise levels <sup>1,2</sup> dBL <sub>Aeq, 8hr</sub>
R1 Crendon House	56	Baseline	<30 - 42
R2 Fernbank	65	Baseline	<30 - <b>69</b>
R3 Crickley Ridge	59	Baseline	<30 - <b>60</b>
R4 Air Balloon Cottages	68	Baseline	<30 - 66
R6 Rushwood Kennels	36	45	<30 - <b>58</b>
R7 Stockwell Farm Barn	39	45	30 - 40
R8 Chestnut Cottage	38	45	<30 - 42
R10 Four Winds	48	55	<30 - 51
R11 Keepers Cottages	34	45	<30 - 40
R12 Shab Hill Farm	36	45	<i>31 - 53</i>
R13 Castle Hill Cottage	67	Baseline	<30 - 53
R14 Nothill, Cowley	34	45	<30 - 33
R15 Crickley Court Cottage	62	Baseline	<30 - <b>65</b>
R17 Holly Brae	58	Baseline	<30 - <b>60</b>

<sup>1</sup> Noise level includes correction for façade acoustic reflection (i.e. noise level at 1m from façade).

<sup>2</sup> Where the cell text is grey/italic, the range of predicted noise levels are below the LOAEL. Where the text is in bold font, the highest predicted value exceeds the ABC potential significance threshold and therefore exceeds the SOAEL for construction noise (see Table 11-3).

<sup>3</sup> Where the baseline noise level is above BS 5228 Category C, the baseline noise level is the SOAEL threshold.

### Residential receptors: effects exceeding the SOAEL at night

- 11.10.41 The ABC night-time potential significance thresholds and therefore the SOAEL would be exceeded during some nights at the following receptors. Nearby receptors which are expected to experience similar noise levels to the assessment receptors are shown in brackets:
- R2 Fernbank (also Grove Lodge, Haroldstone Lodge, Halfacres, The Willows (x2) and The Spinney);
  - R3 Crickley Ridge;
  - R6 Rushwood Kennels
  - R12 Shab Hill Farm (also Shab Hill Barn);
  - R15 Crickley Court Cottage; and
  - R17 Holly Brae.
- 11.10.42 Impacts at R6 and R12 are major and impacts at R2, R3, R15 and R17 are moderate, however, night works would not occur for ten nights or more in 15 consecutive night period nor for 40 nights affecting one location in a six-month period and therefore these impacts are assessed as not significant.
- 11.10.43 In addition, there would be minor noise impacts at R7, R8 (Cuckoopen Barn Farm only), R10 and R11. These impacts are assessed as not significant.
- 11.10.44 Table 11-20 summarises the significant effects for receptors in the study area for the construction assessment

**Table 11-20 Significance of construction noise effects (residential)**

<b>Assessment receptor</b>	<b>Conclusion of significance assessment</b>	<b>Residential/ Non-residential</b>	<b>Justification of significance conclusion</b>
Fernbank, Crickley Hill, Witcombe, Gloucester, GL3 4UQ	Significant Adverse	Residential	Major impact, temporary adverse effect in the daytime – significant in the daytime. Moderate impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold – not significant at night.
Grove Lodge, Crickley Hill, Witcombe, Gloucester, GL3 4UH	Significant Adverse	Residential	Moderate impact, temporary adverse effect in the daytime – significant in the daytime. Moderate impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold – not significant at night.
Haroldstone Lodge, Crickley Hill, Witcombe, Gloucester, GL3 4UQ	Significant Adverse	Residential	Moderate impact, temporary adverse effect in the daytime – significant in the daytime. Moderate impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold– not significant at night.
Halfacres, Badgeworth, Cheltenham, GL3 4UQ	Significant adverse	Residential	Moderate impact, temporary adverse effect in the daytime – significant in the daytime. Moderate impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold– not significant at night.
Ground Floor, The Willows, Badgeworth, Cheltenham, GL3 4UQ	Significant adverse	Residential	Moderate impact, temporary adverse effect in the daytime – significant in the daytime. Moderate impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold – not significant at night.
Top Flat, The Willows, Badgeworth, Cheltenham, GL3 4UQ	Significant adverse	Residential	Moderate impact, temporary adverse effect in the daytime – significant in the daytime. Moderate impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold – not significant at night.

Assessment receptor	Conclusion of significance assessment	Residential/ Non-residential	Justification of significance conclusion
The Spinney, Cold Slad Lane, GL3 4UQ	Significant adverse	Residential	Moderate impact, temporary adverse effect in the daytime – significant in the daytime.  Moderate impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold – not significant at night.
1 Air Balloon Cottages, Crickley Hill, GL4 8JY	Significant adverse	Residential	Major impact, temporary adverse effect in the daytime – significant in the daytime.  No night-time impact.
2 Air Balloon Cottages, Crickley Hill, GL4 8JY	Significant adverse	Residential	Major impact, temporary adverse effect in the daytime – significant in the daytime.  No night-time impact.
Crickley Ridge, Crickley Hill, GL4 8JY	Significant adverse	Residential	Major impact, temporary adverse effect in the daytime – significant in the daytime.  Moderate impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold – not significant at night.
Barrow Wake House, Shab Hill, GL4 8JX	Significant adverse	Residential	Moderate impact, temporary adverse effect in the daytime – significant in the daytime.  Minor impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold – not significant at night.
Rushwood Kennels, Shab Hill, GL4 8JX	Significant adverse	Residential	Major impact, temporary adverse effect in the daytime – significant in the daytime.  Major impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold – not significant at night.
Shab Hill Farm, Shab Hill, GL4 8JX	Significant adverse	Residential	Major impact, temporary adverse effect in the daytime – significant in the daytime..  Major impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold – not significant at night.

Assessment receptor	Conclusion of significance assessment	Residential/ Non-residential	Justification of significance conclusion
Shab Hill Barn, Shab Hill, GL4 8JX	Significant adverse	Residential	Major impact, temporary adverse effect in the daytime – significant in the daytime. Major impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold – not significant at night.
Crickley Court Cottage, Crickley Hill, Witcombe, GL3 4UF	Not significant	Residential	Minor impact, temporary adverse effect in the daytime. Moderate impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold.
Stockwell Farm Barn, Stockwell, GL4 8JZ	Not significant	Residential	Minor impact, temporary adverse effect in the daytime. Minor impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold.
1 Stockwell Cottages, Stockwell, GL4 8JZ	Not significant	Residential	Minor impact, temporary adverse effect in the daytime. Minor impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold.
2 Stockwell Cottages, Stockwell, GL4 8JZ	Not significant	Residential	Minor impact, temporary adverse effect in the daytime. Minor impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold.
3 Stockwell Cottages, Stockwell, GL4 8JZ	Not significant	Residential	Minor impact, temporary adverse effect in the daytime. Minor impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold.
4 Stockwell Cottages, Stockwell, GL4 8JZ	Not significant	Residential	Minor impact, temporary adverse effect in the daytime. Minor impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold.
Stockwell Cottage, Stockwell, GL4 8JZ	Not significant	Residential	Minor impact, temporary adverse effect in the daytime.

Assessment receptor	Conclusion of significance assessment	Residential/ Non-residential	Justification of significance conclusion
			Minor impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold.
Stockwell Farm, Stockwell, GL4 8JZ	Not significant	Residential	Minor impact, temporary adverse effect in the daytime. Minor impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold.
Stockwell Barn A, Stockwell, Birdlip, GL4 8JZ	Not significant	Residential	Minor impact, temporary adverse effect in the daytime. Minor impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold.
Chestnut Cottage, GL53 9NJ.	Not significant	Residential	Minor impact, temporary adverse effect in the daytime only.
Hill Barn Cottage, GL53 9NJ	Not significant	Residential	Minor impact, temporary adverse effect in the daytime only.
Hill Barn, GL53 9NJ	Not significant	Residential	Minor impact, temporary adverse effect in the daytime only.
Cuckoopen Barn Farm, Shab Hill, South Hill, Coberley, GL4 8JX	Not significant	Residential	Minor impact, temporary adverse effect in the daytime. Minor impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold.
1 Keepers Cottages, Cowley Wood, GL3 9PF	Not significant	Residential	Minor impact, temporary adverse effect in the daytime. Minor impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold.
2 Keepers Cottages, Cowley Wood, GL53 9PF	Not significant	Residential	Minor impact, temporary adverse effect in the daytime. Minor impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold.
Nothill, Cowley, GL53 9JN (representing the village of Cowley)	Not significant	Residential	Minor impact, temporary adverse effect in the daytime only.
Holly Brae, Crickley Hill, Witcombe, GL3 4UF	Not significant	Residential	Minor impact, temporary adverse effect in the daytime. Moderate impact, temporary adverse effect in the night-time, not exceeding LA 111 duration threshold.

Assessment receptor	Conclusion of significance assessment	Residential/ Non-residential	Justification of significance conclusion
Emma's Grove (scheduled monument)	Significant adverse	Non-residential	Major impact, temporary adverse effect in the daytime only.
Birdlip radio station	Significant adverse	Non-residential	Major impact, temporary adverse effect in the daytime only.
Rushwood Kennels and Cattery	Significant adverse	Non-residential	Major impact, temporary adverse effect in the daytime only.
Footpaths within around 500m of major excavation works away from existing major roads.	Significant adverse	Non-residential	Major impact, temporary adverse effect in the daytime only.
Crickley Hill Visitor Centre	Not significant	Non-residential	Minor impact, temporary adverse effect in the daytime only.
<b>Summary of effects</b>			
Significant Adverse: 14 dwellings and four non-residential receptors (also representing other footpaths within approximately 500m of major excavation works).			
Not Significant: 17 dwellings (plus residential areas of Cowley) and one non-residential receptor.			

### Diversion Routes

- 11.10.45 LA 111 states that any receptor within 25m of a diversion route used at night will be subject to a major noise impact. Where this major noise impact would exceed ten or more nights in any consecutive 15 nights, or 40 nights in any six consecutive months, this would be considered to be an indirect temporary likely significant effect.
- 11.10.46 At present it is envisaged that there will be one weekend closure and individual weeknight closures (total around 25 nights) over the construction period. One diversion route via A46-A40-B4075-A435-A436 will be used when the A417 is closed between the A46 and Air Balloon roundabout, and a diversion route via A436-A40-A429 will be used when the A417 is closed between Air Balloon roundabout and Burford Road interchange. Each of these would affect a different set of receptors.
- 11.10.47 Table 11-21 shows the localities that traffic diversions at night would pass through together with the residential property count within 25m of the route.

**Table 11-21 Diversion route residential impacts**

Town or Locality	Number of Residential Properties
Andoversford	
<i>Foxcote</i>	1
<i>Garricks Head</i>	2
<i>Other</i>	1
Baunton	1
Birdlip	
<i>Crickley Hill</i>	1
Chedworth	
<i>Fosse Cross</i>	2

Town or Locality	Number of Residential Properties
<i>Fossebridge</i>	4
Cheltenham	
<i>Badgeworth</i>	5
<i>Bentham</i>	1
<i>Charlton Kings</i>	236
<i>Shurdington</i>	141
<i>Up Hatherley</i>	32
<i>Other</i>	660
Cirencester	2
Coberley	2
Coln St Dennis	5
Compton Abdale	1
Dowdeswell	1
Hazleton	1
Northleach	16
Seven Springs	1
Shipton Oliffe	6
Ullenwood	8
Yanworth	1
<b>Total</b>	<b>1131</b>

- 11.10.48 A total of 1131 properties are within 25m of a diversion route and would experience a major impact during night-time closures when traffic is diverted past their properties. However, night-time closures will be limited to a minimum, being required only during the installation and removal of traffic management measures.
- 11.10.49 Management measures will be put in place to ensure that no property would be subjected to additional traffic impacts due to night-time diversions for ten or more nights in any 15 consecutive nights, or 40 nights in any six consecutive months. On that basis, traffic using diversion routes at night is determined as being not significant. A Traffic Management Plan would be submitted as part of the DCO application.

#### Specific mitigation

- 11.10.50 The potential for mitigation has been discussed in section 11.9. Due to the linear nature and large area of the cutting and earthworks, specific mitigation to avoid significant effects in the form of noise barriers is unlikely to be practicable or effective. As the cutting deepens, some inherent screening will occur for some receptors, however, significance thresholds are still likely to be exceeded for at least part of the construction period.
- 11.10.51 Due to the isolated nature of most of the significantly affected receptors and the duration of the potential effects, noise insulation at individual properties may be the most cost effective and technically effective solution. A strategy for assessing and determining lability for individual property noise insulation packages will be developed and presented as part of the DCO application.
- 11.10.52 Additional specific mitigation will be included, where relevant, in the EMP (which will be produced and submitted as part of the DCO application). The EMP will



also include details of the monitoring regime and stakeholder communication strategy.

- 11.10.53 Although there will be major impacts from diversion routes at night (although these are not assessed as significant given the duration of these events), additional mitigation is not considered practicable in this case.

#### Vibration

- 11.10.54 Groundborne vibration resulting from the construction of the proposed scheme has been considered and the following vibration-intensive construction operations have been identified and assessed. The greatest sources of vibration will arise from the use of vibratory compaction plant during earthwork and road pavement construction activities, and from the use of large breakers during the excavation works for the various road cuttings. This would be most prevalent in the deep cutting immediately to the west and south of Air Balloon roundabout.
- 11.10.55 Piling works will also be required, to undertake the construction of the retaining wall along the cut line around the main cutting between Chainage 2+800 to 1+700 along the westbound carriageway and also for ground consolidation works at the Shab Hill junction. All piling activities are expected to be undertaken using the CFA (continuous flight auger) method. This piling method generates very low vibration levels even at close proximity to the piling rig and as such the potential for adverse vibration effects would be low. Therefore, it is considered unlikely that using this piling method would generate significant vibration effects.
- 11.10.56 Removal of the existing section of A417 road pavement between Air Balloon roundabout and Cowley junction will be undertaken using hand-held pneumatic breakers. The use of this type of plant is not expected to result in significant levels of groundborne vibration at the closest residential properties where this work will be undertaken. There will also be road pavement removal works undertaken along redundant sections of the existing A417 carriageway (including the existing Air Balloon roundabout), where changes in road alignment as part of the proposed scheme design will be required between Air Balloon roundabout and the Brockworth junction.
- 11.10.57 The vibration effects in these specific areas would depend upon the exact detail of the local ground conditions, which would govern the duration of the works, and the precise proximity of where these particular activities would occur in relation to the closest residential properties. Neither of these factors can be determined with a high level of accuracy at this stage, but it is envisaged that these works would progress quickly i.e. passing any given receptor within a matter of a few days along these stretches of redundant carriageways. As such it is considered that this would result in a not significant effect.
- 11.10.58 There are three particular construction stages where specific plant activities would potentially give rise to high vibration levels: rock breaking, road pavement surfacing and earthworks:
- Rock-breaking activities – the proposed scheme section between chainage 1+700 and 2+800, where the deep cutting works will be required, is where the majority of rock breaking activity would occur, and which is likely to result in the highest vibration levels. These rock-breaking activities would be undertaken using percussive peckers or breakers attached to heavy excavators.

- Pavement surfacing and earthworks – It is expected that the majority of fill material required along the scheme alignment will require compaction using a variety of different sized vibratory compactors.

11.10.59 The potential vibration effects of the above construction activities have been considered with reference to BS 5228-2 (see Table 11-8) for human response, and BS 7385-2 to quantify the potential for risk of cosmetic damage to buildings (see Table 11-10).

11.10.60 Table 11-22 shows the predicted construction vibration levels, in terms of peak particle velocity (PPV) at the nearest sensitive receptors. The locations represent sensitive receptors (residential and non-residential receptors) for selected construction activities which might give rise to construction vibration effects. The PPVs shown in Table 11-22 are representative of the instantaneous worst case vibration predicted on occasions for a period of time during the closest approach of the works to each sensitive receptor. The receptors for the vibration assessment are the same as those for which construction noise was assessed.

**Table 11-22 Construction vibration levels**

Loc. ID	Receptor description (see Figure 11.1)	Peak Particle Velocity (PPV, mm/s)		
		Rock-breaking	Earthworks	Road pavement surfacing <sup>1</sup>
R1	Crendon House	0.1	0.0	0.0
R2	Fernbank	0.3	1.1	5.0
R3	Crickley Ridge	0.8	0.2	0.6
R4	Air Balloon Cottages	1.4	0.2	7.4
R5	Birdlip Radio Station *	0.2	0.5	3.7
R6	Rushwood Kennels	0.3	0.1	0.6
R7	Stockwell Farm Barn	0.1	0.0	0.1
R8	Chestnut Cottage	0.1	0.0	0.0
R9	Crickley Hill Visitor Centre*	0.2	0.0	0.1
R10	Gloucestershire Way*	0.2	0.0	0.1
R11	Keepers Cottage *	0.1	0.0	0.0
R12	Shab Hill Farm and Barn	0.1	0.1	0.8
R13	Castle Hill Cottage	0.3	0.0	0.1
R14	Nothill, Cowley	0.5	0.0	0.0
R15	Crickley Court Cottage	0.1	0.2	1.7
R16	Emma's Grove*	0.6	0.1	0.4
R17	Holly Brae	0.0	0.1	0.6

<sup>1</sup> Predicted road pavement vibration levels are much higher than those for earthworks in some cases because the earthworks would be more distant than pavement works, although pavement works would progress more quickly along the route.

\*Non-residential receptors

11.10.61 The vibration levels at all receptor locations during both rock-breaking and earthworks activities, except for Fernbank (R2) and Air Balloon Cottages, are predicted to be below the SOAEL (1.0mm/s) as shown in Table 11-8. At Fernbank, the earthworks compaction during the construction of the A417 embankment, is predicted to generate PPV up to 1.1mm/s which would just exceed the SOAEL during the closest passbys of vibratory compaction plant. In

order to avoid vibration levels exceeding the SOAEL in this area, compaction plant should be operated in 'static' mode when operating within no less than 20m from this property. This would be detailed in the EMP accompanying the DCO application.

- 11.10.62 Vibration at properties at R7, R8, R11, R12 and R15 will be below the LOAEL. These vibration levels are also well below the onset of potential cosmetic damage to buildings (Table 11-10). It would be expected therefore, that disturbance to, and complaints from residents due to the effects of these particular stages of construction works would be unlikely and is rated as a minor impact.
- 11.10.63 The vibration levels predicted during road pavement surfacing activities, would result in five receptors (R2, R4, R5 and R15) exceeding the SOAEL. Of these, R5 is a non-residential building (Birdlip Radio Station). The exceedances predicted at the four residential receptor locations indicate that 'complaint is likely' from residents during pavement surfacing works. Therefore, it is assessed that vibration levels generated by road surfacing activities at each of these receptors would be a moderate impact above a SOAEL, as indicated in criteria Table 11-9. The vibration levels are below the level at which 'onset of cosmetic damage' might occur at all but R4 representing Air Balloon Cottages. With the measures described in 11.10.61 i.e. to only operate compaction plant in 'static' mode when operating within no less than 20m from the properties, vibration levels will be constrained below 6mm/s PPV and would therefore avoid breaching the conservative thresholds as set out in Table 11-10 below which there is no risk of cosmetic damage.
- 11.10.64 The general construction processes proposed for the main scheme alignment, where the use of intensive vibration generating plant has been identified, will largely follow a linear progression along the scheme route. The duration of the SOAEL exceedances predicted during the road pavement works is therefore estimated to be of short duration i.e. less than ten days, hence these impacts are assessed as not significant.
- 11.10.65 Underground horizontal drainage pipes will need to be installed at regular intervals (approximately 10m) along part of the Crickley Hill Escarpment. These drainage pipes are likely to be installed as close as 10m either side of the Fernbank residential property. It is not expected that these drilling operations will last for more than one day per pipe installation. The vibration levels generated from this work are not estimated to exceed the SOAEL. Given the nature and distance of these works, this may be audible at times as 'groundborne' noise inside Fernbank during the closest drainage installation either side of this property. However, as this work will be for only a very short duration (approximately two days for both of the closest drainage installations), this is assessed as not significant.

### **Operation effects**

- 11.10.66 Daytime and night-time traffic noise levels within the study area have been predicted and are assessed in terms of direct and indirect effects for:
- Residential receptors exceeding the SOAEL;
  - Residential receptors between the LOAEL and SOAEL; and
  - Non-residential receptors.

- 11.10.67 Table 11-23 summarises the assessment of the significant effects for daytime and night-time resulting from the proposed operational scheme in the short term and long term. All the assessment results assume that the mitigation measures described in Table 11-17 as well as the lower noise road surface are incorporated into the proposed design.
- 11.10.68 Figure 11.2 shows the long-term noise level contours. Figure 11.3 shows the noise difference contours (i.e. the changes in noise) resulting from the proposed operational scheme between the baseline and the future year (2039). These figures should be referred to for the following assessment description. The noise contours shown on these figures are representative of the noise levels at 4m above local ground level. Appendix 11.4 provides tabulated noise level results.
- 11.10.69 In the paragraphs below, the overall noise impacts are summarised separately for each of the three proposed scheme sections, west to south, as previously described under baseline conditions (section 11.7), i.e.:
- Bentham to Air Balloon roundabout – 0+000 to 2+100;
  - Air Balloon roundabout to Cowley junction – existing alignment; and
  - Air Balloon roundabout to Cowley junction – proposed re-alignment – 2+100 to 5+760.
- 11.10.70 Following these summaries, the numbers of receptors affected above the SOAEL threshold, and the numbers affected between the SOAEL and LOAEL thresholds are described for the whole proposed scheme.

Bentham to Air Balloon roundabout – 0+000 to 2+100

- 11.10.71 On the western section, between 0+000 to 0+500 the proposed scheme would be aligned with the existing A417. Further east, the scheme would move slightly to the south. As shown in Figure 11.3 (noise change contour map), traffic noise levels immediately around the highway would be increased on the southern side. At Witcombe, noise levels would be subject to negligible change (i.e. less than 1dB(A) increase or decrease). Larger noise increases would affect two isolated dwellings and commercial premises on the southern side alongside the highway. Further from the road, Figure 11.3 shows noise changes generally less than 1dB(A) at distances up to approximately 500m. Approximately 600m south of the alignment, The Peak (SM) would be subject to a negligible noise change.
- 11.10.72 On the north side of the proposed scheme, noise reductions (i.e. greater than 1dB(A)) would occur over much of the escarpment ascending to Crickley Hill and the wider area of the Country Park, including Crickley Hill Camp (SM). Between chainages 1+600 and 2+150 within 30m from the scheme, parts of the Country Park at the bottom of the hill would be subject to noise reductions of between 3dB and 10dB due to the scheme realignment. There would be smaller noise reductions further up the hill, with some areas subject to a small increase as a result of being more exposed to the more elevated section of the realigned A417. The noise reductions are partly due to the removal of the existing A417 immediately south of the Air Balloon roundabout down to Cowley junction. Residential properties on the northern side would be subject to negligible noise changes, or increases between 1 to 3 dB(A), and in a few cases as high as 5dB(A), where properties are now more exposed due to the southerly realignment and increased elevation of the A417. Air Balloon Cottages (near the roundabout) would be subject to large noise reductions.

### Air Balloon roundabout to Cowley junction– existing alignment

- 11.10.73 On the northern part of this section (north of the B4070), there would be noise reductions either side of the removed A417 existing alignment (i.e. between 5 and 10dB(A) reductions approximately 100m either side of the removed highway). East of the removed A417 there would be noise reductions of between 3 and 10dB(A) toward Emma's Grove (SM). South of the B4070, noise reductions up to 10dB(A) would occur on the east side of Birdlip, with reductions up to 5dB(A) further towards the centre of village.
- 11.10.74 South-east of Birdlip towards Cowley junction, noise reductions greater than 10dB(A) would also occur at a group of residential properties at Hawcote Hill. Similar noise reductions would occur at scattered dwellings closer to Cowley junction, near the Golden Heart Inn.

### Air Balloon roundabout to Cowley junction– proposed re-alignment – 2+100 to 5+760

- 11.10.75 North of Shab Hill junction with the proposed extension to the B4070, noise level increases greater than 10dB(A) would occur at up to several hundred metres on the east side of the proposed scheme away from existing roads. This noise increase would be greater without the proposed noise mitigation in place on either side of the junction (refer to Table 11-17). Because of the complex nature of the topography surrounding the proposed Shab Hill junction, it is not practicable to provide further reductions to these residual noise increases. There are few properties on this section of the scheme, where these adverse noise increases have been predicted. These noise increases would affect Birdlip Radio Station, the Rushwood Kennels and Cattery (including the associated residential property) and part of the Gloucestershire Way where it would be realigned.
- 11.10.76 South of Shab Hill junction, noise bunds have been included in the proposed scheme design to reduce noise impacts to the surrounding area. South-west of the junction, Shab Hill Farm would be subject to noise increases of over 10dB(A). The noise increase would also affect a number of footpaths (see Figure 11-4) both crossing and aligned parallel to the scheme, including some areas of 10dB(A) increase. The community at Stockwell, to the south-west of the scheme at chainage 4+000 would be affected by noise increases of between 1 to 5dB(A).
- 11.10.77 The village-centre of Cowley is some 1500m to the east of the proposed scheme. The topography is such that there would be no direct line of sight towards the scheme from the village itself. Noise changes of less than 1dB(A) would occur at the centre of the village (negligible change).

### Assessment of significant effects

- 11.10.78 Table 11-23 summarises areas alongside the proposed scheme where significant effects have been assessed. The text following the table describes further detail on the types of effect as well as effects in NIAs and on non-residential locations (e.g. PRowS in the AONB). The assessment is based upon the change in noise caused by the proposed scheme, with consideration of other factors relating to the context of the impact such as the level of noise exposure with and without the scheme (see Table 11-15).

**Table 11-23 Significance of operational noise effects (residential)**

<b>Receptor</b>	<b>Conclusion of significance assessment</b>	<b>Direct or indirect effect</b>	<b>Magnitude of change and justification of significance conclusion</b>
1 Air Balloon Cottages, Crickley Hill, GL4 8JY	Significant beneficial	Direct	<i>(See operational criteria in Table 11-11 to Table 11-15, for thresholds and other criteria considered in determining significance. Additional explanation is given in the paragraphs following this table).</i>
			Major impact, beneficial effect in the short term and decreasing to moderate beneficial effect in the long term.
2 Air Balloon Cottages, Crickley Hill, GL4 8JY	Significant beneficial	Direct	Major impact, beneficial effect in the short term and decreasing to moderate beneficial effect in the long term .
1 Crickley Cottages, Crickley Hill, Badgeworth, Cheltenham, GL3 4UQ	Significant Adverse	Direct	Moderate impact, adverse effect in the short term decreasing to minor impact, adverse effect in the long term.
2 Crickley Cottages, Crickley Hill, Badgeworth, Cheltenham, GL3 4UQ	Significant adverse	Direct	Minor impact, adverse effect in the short term and long term.
3 Crickley Cottages, Crickley Hill, Badgeworth, Cheltenham, GL3 4UQ	Significant adverse	Direct	Minor impact, adverse effect in the short term and long term.
1 Oxford Cottages, GL53 9QX	Significant beneficial	Indirect	Minor impact, beneficial effect in the short term only
2 Oxford Cottages, GL53 9QX	Significant beneficial	Indirect	Minor impact, beneficial effect in the short term only
6 Ridgeway Close, GL4 8BN	Significant beneficial	Direct	Minor impact, beneficial effect in the short term only.
Applegarth, GL4 8JH	Significant beneficial	Direct	Major impact, beneficial effect in the short term decreasing to moderate impact, beneficial effect in the long term.
April Cottage, GL4 8JH	Significant beneficial	Direct	Major impact, beneficial effect in the short term and long term.
Barn, Hill Farm, Witcombe, GL3 4SL	Significant beneficial	Indirect	Moderate impact, beneficial effect in the short term only.
Barrow Wake House, Shab Hill, GL4 8JX	Significant beneficial	Direct	Major impact, beneficial effect in the short term decreasing to moderate impact, beneficial effect in the long.
Berrywood House, GL4 8JH	Significant beneficial	Direct	Minor impact, beneficial effect in the short term only.

<b>Receptor</b>	<b>Conclusion of significance assessment</b>	<b>Direct or indirect effect</b>	<b>Magnitude of change and justification of significance conclusion</b>
Birdlip Farm Barn, GL4 8JH	Significant beneficial	Direct	Major impact, beneficial effect in the short term decreasing to moderate impact, beneficial effect in the long term.
Birdlip House, GL4 8JH	Significant beneficial	Direct	Major impact, beneficial effect in the short term decreasing to moderate impact, beneficial effect in the long term.
Birdlip View, Cirencester Road, GL4 8JL	Significant beneficial	Direct	Major impact, beneficial effect in the short term and long term.
Black Horse Ridge, Stroud Road, Birdlip, Gloucester, GL4 8JN	Significant beneficial	Indirect	Moderate impact, beneficial effect in the short term only.
Buckingham House, GL4 8JH	Significant beneficial	Direct	Minor impact, beneficial effect in the short term only
Castle Hill Cottage, Nettleton Bottom, GL4 8LA	Significant beneficial	Direct	Major impact, beneficial effect in the short term and long term.
Cedarwood House, GL4 8JH	Significant beneficial	Direct	Minor impact, beneficial effect in the short term only.
Chestnut House, GL4 8JH	Significant beneficial	Direct	Minor impact, beneficial effect in the short term only.
Clare Cottage, GL4 8JH	Significant beneficial	Direct	Major impact, beneficial effect in the short term decreasing to moderate impact, beneficial effect in the long term.
Corner Cottage, GL4 8JH	Significant beneficial	Direct	Minor impact, beneficial effect in the short term only.
Cotswold Cottage, GL4 8JH	Significant beneficial	Direct	Major impact, beneficial effect in the short term decreasing to moderate impact, beneficial effect in the long term.
Crendan House, GL53 9QX	Significant beneficial	Direct	Major impact, beneficial effect in the short term and long term
Crickley Court, Crickley Hill, Witcombe, Gloucester, GL3 4UF	Significant beneficial	Direct	Moderate impact, beneficial effect in the short term only.
Crickley Hall, Crickley Hill, Witcombe, Gloucester, GL3 4UQ	Significant Adverse	Direct	Minor impact, adverse effect in the short term and long term
Crickley Hill Farm Cottage, Witcombe, Gloucester, GL3 4UF	Significant Adverse	Direct	Minor impact, adverse effect in the short term.
Crickley Hill Farm, Witcombe, Gloucester, GL3 4UF	Significant Adverse	Direct	Minor impact, adverse effect in the short term.
Crickley Ridge, Crickley Hill, GL4 8JY	Significant beneficial	Direct	Major impact, beneficial effect in the short term reducing to moderate beneficial in the long term.

<b>Receptor</b>	<b>Conclusion of significance assessment</b>	<b>Direct or indirect effect</b>	<b>Magnitude of change and justification of significance conclusion</b>
Devon House, GL4 8JH	Significant beneficial	Indirect	Minor impact, beneficial effect in the short term and long term.
Ermin Cottage, GL4 8JH	Significant beneficial	Direct	Major impact, beneficial effect in the short term decreasing to moderate impact, beneficial effect in the long term.
Fernbank, Crickley Hill, Witcombe, Gloucester, GL3 4UQ	Significant beneficial	Direct	Major impact, beneficial effect in the short term above the SOAEL decreasing to moderate impact, beneficial effect in the long term.
Flat Willows, Witcombe, Gloucester, GL3 4UQ	Significant Adverse	Direct	Moderate impact, adverse effect in the short term decreasing to minor impact, adverse effect in the long term.
Flat, The Green Dragon, Cockleford, Cowley, GL53 9NW	Significant beneficial	Indirect	Minor impact, beneficial effect in the short term and long term
Four Winds, 1 Shab Hill, GL4 8JX	Significant beneficial	Direct	Major impact, beneficial effect in the short term and long term.
Ground Floor, The Willows, Badgeworth, Cheltenham, GL3 4UQ	Significant Adverse	Direct	Minor impact, adverse effect in the short term and long term
Half Acre, Crickley Hill, Witcombe, Gloucester, GL3 4UQ	Significant Adverse	Direct	Minor impact, adverse effect in the short term and long term
Halfacres, Badgeworth, Cheltenham, GL3 4UQ	Significant beneficial	Direct	Minor impact, beneficial effect in the short term only.
Haroldstone House, Crickley Hill, Badgeworth, Cheltenham, GL3 4UQ	Significant Adverse	Direct	Moderate impact, adverse effect in the short term decreasing to Minor adverse in the long term.
Haroldstone Lodge, Cold Slad Lane, Badgeworth, GL3 4UQ	Significant Adverse	Direct	Moderate impact, adverse effect in the short term, decreasing to minor impact, adverse effect in the long term.
Haroldstone Lodge, Crickley Hill, Witcombe, Gloucester, GL3 4UQ	Significant Adverse	Direct	Moderate impact, adverse effect in the short term, decreasing to minor impact, adverse effect in the long term.
Hawcote House, Hawcote Hill, Cirencester Road, GL4 8JL	Significant beneficial	Direct	Major impact, beneficial effect in the short term and long term.
Hawthorn House, GL4 8JH	Significant beneficial	Direct	Minor impact, beneficial effect in the short term only.
Highclere, Cirencester Road, GL4 8JL	Significant beneficial	Direct	Major impact, beneficial effect in the short term and long term.
Highridge, Birdlip, Gloucester, GL4 8JN	Significant beneficial	Indirect	Moderate impact, beneficial effect in the short term only.



<b>Receptor</b>	<b>Conclusion of significance assessment</b>	<b>Direct or indirect effect</b>	<b>Magnitude of change and justification of significance conclusion</b>
Hillcot, Cirencester Road, GL4 8JL	Significant beneficial	Direct	Major impact, beneficial effect in the short term and long term.
Ivy Lodge, GL4 8JH	Significant beneficial	Direct	Minor impact, beneficial effect in the short term only.
Kellands Farm, GL4 8JH	Significant beneficial	Direct	Major impact, beneficial effect in the short term decreasing to moderate impact, beneficial effect in the long term.
Knapp Cottage, Birdlip Hill, Witcombe, Gloucester, GL3 4SL	Significant beneficial	Indirect	Moderate impact, beneficial effect in the short term only.
Knapp House, Witcombe, Gloucester, GL3 4SJ	Significant beneficial	Indirect	Moderate impact, beneficial effect in the short term only.
Knapp Lodge, Birdlip Hill, Witcombe, Gloucester, GL3 4SL	Significant beneficial	Indirect	Moderate impact, beneficial effect in the short term only.
Laurel Cottage, GL53 9QX	Significant beneficial	Indirect	Minor impact, beneficial effect in the short term only.
Leaside, Nettleton Bottom, GL4 8LA	Significant beneficial	Direct	Major impact, beneficial effect in the short term and long term.
Michaelmas House, GL4 8JH	Significant beneficial	Direct	Major impact, beneficial effect in the short term decreasing to moderate impact, beneficial effect in the long term.
Mockingbird House, GL4 8JH	Significant beneficial	Direct	Minor impact, beneficial effect in the short term only.
Mosella Cottage, GL53 9QX	Significant beneficial	Indirect	Minor impact, beneficial effect in the short term only.
Old Ullenwood Lodge, GL53 9QX	Significant beneficial	Indirect	Minor impact, beneficial effect in the short term only.
Pheasants Keep, Hawcote Hill, Cirencester Road, GL4 8JL	Significant beneficial	Direct	Major impact, beneficial effect in the short term and long term.
Pixwold, Cockleford, GL53 9NW	Significant beneficial	Indirect	Minor impact, beneficial effect in the short term and long term.
Purdey House, Hawcote Hill, Cirencester Road, GL4 8JL	Significant beneficial	Direct	Major impact, beneficial effect in the short term and long term.
Ridge Cottage, Stroud Road, Birdlip, Gloucester, GL4 8JN	Significant beneficial	Indirect	Moderate impact, beneficial effect in the short term only.
Rose Cottage, Cirencester Road, GL4 8JL	Significant beneficial	Direct	Major impact, beneficial effect in the short term and long term.

<b>Receptor</b>	<b>Conclusion of significance assessment</b>	<b>Direct or indirect effect</b>	<b>Magnitude of change and justification of significance conclusion</b>
Rushwood Kennels (residence), Shab Hill, South Hill, Coberley, GL4 8JX	Significant Adverse	Direct	Major impact, adverse effect in the short term and long term.
Shab Hill Farm, Shab Hill, GL4 8JX	Significant Adverse	Direct	Major impact, adverse effect in the short term and long term.
Shab Hill Barn, Shab Hill, GL4 8JX	Significant Adverse	Direct	Major impact, adverse effect in the short term and long term.
Skyfall House, GL4 8JH	Significant beneficial	Direct	Moderate impact, beneficial effect in the short term decreasing to minor impact, beneficial effect in the long term.
Springfield Bungalow, GL4 8JH	Significant beneficial	Direct	Major impact, beneficial effect in the short term decreasing to moderate impact, beneficial effect in the long term.
Staff House, Corner Cottage, GL4 8JH	Significant beneficial	Indirect	Minor impact, beneficial effect in the short term only.
The Cottage Catchbar, Cirencester Road, GL4 8JL	Significant beneficial	Direct	Major impact, beneficial effect in the short term and long term.
The Dower House, Birdlip Hill, GL3 4SL	Significant beneficial	Indirect	Moderate impact, beneficial effect in the short term only.
The Flat, The Willows, Witcombe, Gloucester, GL3 4UQ	Significant Adverse	Direct	Moderate impact, adverse effect in the short term decreasing to minor impact, adverse effect in the long term.
The Grove, GL53 9QX	Significant beneficial	Indirect	Minor impact, beneficial effect in the short term only.
The Knapp, Witcombe, Gloucester, GL3 4SL	Significant beneficial	Indirect	Moderate impact, beneficial effect in the short term only.
The Muzzards, The Common, GL4 8LB	Significant beneficial	Direct	Major impact, beneficial effect in the short term decreasing to moderate impact, beneficial effect in the long term.
The Nest, Birdlip Farm, GL4 8JH	Significant beneficial	Direct	Moderate impact, beneficial effect in the short term only
The Old Pyke House, Cirencester Road, GL4 8JL	Significant beneficial	Direct	Major impact, beneficial effect in the short term and long term.
The Rise, Stockwell, GL4 8JZ	Significant beneficial	Direct	Major impact, beneficial effect in the short term decreasing to moderate impact, beneficial effect in the long term.
The Spinney, Crickley Hill, Badgeworth, GL3 4UQ	Significant Adverse	Direct	Moderate impact, adverse effect in the short term decreasing to minor impact, adverse effect in the long term

Receptor	Conclusion of significance assessment	Direct or indirect effect	Magnitude of change and justification of significance conclusion
The Willows, Badgeworth, Cheltenham, GL3 4UQ	Significant Adverse	Direct	Moderate impact, adverse effect in the short term decreasing to minor impact in the long term
The Willows, Crickley Hill, Witcombe, Gloucester, GL3 4UQ	Significant Adverse	Direct	Moderate impact, adverse effect in the short term decreasing to minor impact in the long term
Top Flat, The Willows, Badgeworth, Cheltenham, GL3 4UQ	Significant Adverse	Direct	Moderate impact, adverse effect in the short term decreasing to minor impact in the long term
Tophers Cottage, Crickley Hill, Badgeworth, Cheltenham, GL3 4UQ	Significant Adverse	Direct	Minor impact, adverse effect in the short term and long term
Welwyn, Cirencester Road, GL4 8JL	Significant beneficial	Direct	Major impact, beneficial effect in the short term and long term.
White Towers, Dog Lane, Witcombe, Cheltenham, GL3 4UG	Significant Adverse	Direct	Minor impact, adverse effect in the short term and long term.
Willow House, GL4 8JH	Significant beneficial	Direct	Minor impact, beneficial effect in the short term only.
Woodside, Nettleton Bottom, GL4 8LA	Significant beneficial	Direct	Major impact, beneficial effect in the short term and long term.
Yew Tree Cottage, Crickley Hill, Witcombe, Gloucester, GL3 4UQ	Significant Adverse	Direct	Moderate impact, adverse effect in the short term and long term.
<b>Summary of effects:</b> Significant Adverse above the SOAEL: 2 dwellings Significant Beneficial above the SOAEL: 29 dwellings Significant Adverse (between LOAEL and SOAEL): 20 dwellings Significant Beneficial (between LOAEL and SOAEL): 36 dwellings Not Significant: 317 dwellings Negligible effects above SOAEL: 5 dwellings			

*Residential receptors: direct effects exceeding the SOAEL*

- 11.10.79 There are two dwellings with noise exposure levels above the SOAEL<sup>xix</sup> predicted to be subject to direct adverse effects from increased noise levels in the short term. This refers to a direct effect where there is at least a 1dB(A) impact as a result of the proposed scheme. These are Crickley Hill Farm and Crickley Hill Farm Cottage. This follows the LA 111 assessment of significance criteria described in Table 11-15 (assessment factor 3.2). These increases are assessed as direct permanent likely significant observed adverse effects.
- 11.10.80 For five dwellings that would already exceed the SOAEL in the baseline year in the absence of the proposed scheme, there would be negligible noise change

<sup>xix</sup> SOAEL as described in Para 11.4.21.

with the scheme. This describes a change of less than 1dB, and hence no adverse or beneficial effect. These are The Lodge, Gillsland Cottage, Cottage on Ridge, and 6 and 7 Ivy Lodge Barns.

- 11.10.81 There are five dwellings currently exceeding the SOAEL where larger noise reductions would occur as a result of the proposed scheme (as shown in the noise difference contours – Figure 11.3). These are No. 1 and 2 Air Balloon Cottages, Crickley Court, Halfacres and Fernbank. For a further 12 dwellings, noise exposure would fall below the SOAEL with the scheme in operation. All the above noise reductions would be greater than 1dB(A) and because the baseline noise level would be above the SOAEL, this level of reduction is assessed as direct permanent likely significant beneficial effect for these dwellings. This follows the LA 111 assessment of significance criteria described in Table 11-15 (assessment factor 3.2).

*Residential receptors: indirect effects exceeding the SOAEL*

- 11.10.82 For seven dwellings that would already exceed the SOAEL in the baseline year in the absence of the proposed scheme, there would be noise reductions as a result of the scheme. These indirect effects would be as a result of changes in road traffic noise associated with non-scheme roads. These properties are No. 1 and 2 Oxford Cottages, Crendan House, Mosella Cottage, The Grove, Old Ullenwood Lodge and Laurel Cottage. For five dwellings, Pixwold, The Knapp, Staff House, Devon Cottage and Corner Cottage, noise exposure would fall below the SOAEL with the scheme in operation. All the above noise reductions would be greater than 1dB(A) and because the baseline noise level would be above the SOAEL, these reductions are assessed as indirect permanent likely significant beneficial effects.

*Residential receptors: direct effects between LOAEL and SOAEL*

- 11.10.83 There are 20 dwellings with a moderate or major level of impact predicted in the short term with the proposed scheme. These would be subject to direct permanent likely significant adverse effects. Specific mitigation has been included in the proposed scheme design. However, it is not practicable to avoid all significant effects where the locations or elevations of the dwellings relative to the scheme would mean that roadside noise screening would not be effective for these properties.
- 11.10.84 There are 27 dwellings subject to direct permanent likely significant beneficial effects between the LOAEL and SOAEL as a result of the proposed scheme. The level of beneficial impact would be major for all these dwellings.

*Residential receptors: indirect effects between LOAEL and SOAEL*

- 11.10.85 There are nine dwellings (The Dower House, Barn (Hill Farm), High Ridge, Knapp House, Knapp Cottage, The Knapp Lodge, Flat at Green Dragon, Ridge Cottage and Blackhorse Ridge) predicted to be subject to moderate beneficial noise reductions, with the exception of the Flat at the Green Dragon which is a minor beneficial reduction. These are assessed as indirect permanent likely significant beneficial effects. This would be as a result of changes in road traffic noise associated with non-scheme roads.

*Residential receptors: effects below LOAEL*

- 11.10.86 LA 111 requires that noise impacts are considered for all levels of noise exposure, although noise levels below the LOAEL would not be assessed as adverse effects in policy terms (refer to Table 11-3 and Table 11-11).
- 11.10.87 At residential properties, noise levels below the LOAEL may be assessed as special cases for particularly sensitive settings as identified in the tranquillity assessment (Chapter 7, Landscape and Visual). The methodology for assessing noise impacts in areas below the LOAEL is described in paragraphs 11.4.43 to 11.4.47.
- 11.10.88 There are 209 properties within the study area that would be subject to noise levels below the LOAEL with the proposed scheme in the baseline year. Most (153) of these properties would be subject to a reduction in noise levels as a result of the scheme (minor to major beneficial impact range).
- 11.10.89 Referring to the national relative tranquillity mapping (Figure 7.9 of the Chapter 7 Landscape and Visual) none of these properties is located in a particularly sensitive, high tranquillity area. Therefore, no significant noise effects, either beneficial or adverse, have been determined as special cases for residential properties below the LOAEL.

*Non-residential sensitive receptors: effects*

- 11.10.90 Several non-residential receptors in Birdlip will be subject to noise reductions as a result of the removal of the existing A417 close to the village - as can be seen from Figure 11.3. These are, Birdlip Primary School (moderate beneficial impact in the long term), Birdlip Village Hall (major beneficial impact), and Birdlip Church (moderate beneficial impact in the long term). These are all subject to noise reductions which are assessed as direct permanent likely significant beneficial effects.
- 11.10.91 Around chainage 1+600 towards the Air Balloon roundabout, the new highway alignment would move southwards from its existing position. Between chainages 1+200 and 2+100, within 100m from the proposed scheme, parts of the Country Park at the bottom of the hill would be subject to noise reductions of between 5 and 10dB(A) as shown in Figure 11.4 (representative of noise levels at a height of 1.5m above local ground level).
- 11.10.92 Noise reductions in 'The Scrubbs' area and footpaths on the escarpment rising up to the Country Park would result in a negligible reduction in traffic noise exposure in this outdoor amenity area. The Park is also designated as an SSSI and a SM. As well as cultural heritage assets, Crickley Hill includes popular footpaths within the area of noise impact, including the Gloucestershire Way, Cotswold Way, and Gustav Holst Way. The magnitude and spatial extent of the noise reductions across this designated site is assessed as not significant.
- 11.10.93 South of the Air Balloon roundabout, the removal of the existing highway would result in noise reductions of between 5 and 10dB(A) approximately 100m either side of the removed highway (including Emma's Grove scheduled monument). The Cotswold Way, on the section of the footpath between Air Balloon roundabout and Barrow Wake view point (shown on Figure 11.4), would be subject to noise reductions of between 5 and 10dB(A) or more. These noise reductions, for the Cotswold way itself where it is close to the alignment of the removed road are assessed as a direct permanent likely significant beneficial

effect. Further west, The Peak (Neolithic enclosure, heritage asset) would be subject to a noise change of less than a 1dB(A) (negligible) increase.

- 11.10.94 Further south, the section of footpath from just north of Birdlip, running east across the removed road (ACY43<sup>xx</sup> – see Figure 11.4) and turning south to Parson's Pitch (ACY10) (800m in length) would be subject to noise reductions of between 5 and 10dB(A) or more. These noise reductions for this section of the footpath are assessed as a direct permanent likely significant beneficial effect.
- 11.10.95 South of Birdlip, footpaths in the following areas would be subject to noise reductions of between 1 and over 10dB(A) in the long term: Beechwoods SSSI (BBR13), Hawcote Hill (ACY17), Birtlan Grove (BBR14), Brimpsfield SSSI (BBR15). Given the proportions of these footpaths that are beneficially affected, these noise reductions are assessed as a direct permanent likely significant beneficial effect. The exception to this in this area is the smaller noise reduction at the footpath at Hawcote Copse (BBR12) which is assessed as not significant.
- 11.10.96 To the south-east of the Air Balloon roundabout, the new alignment would result in noise increases around the proposed scheme. The incorporated noise mitigation design around this new alignment (see Figure 11.4) would minimise, as far as reasonably practicable, noise levels to the surrounding footpaths and other noise sensitive receptors.
- 11.10.97 Noise impacts in the area of the proposed new alignment would affect the Gloucestershire Way crossing this area of land. The baseline noise levels for this part of the footpath range from 60dB<sub>L<sub>Aeq,16hr</sub></sub> or above close to the east side of the existing alignment (see Figure 11.1); and as quiet as 40dB<sub>L<sub>Aeq,16hr</sub></sub> (below LOAEL) in the lower-lying area of the proposed scheme corridor furthest from existing roads. This section of the footpath is considered in this assessment to be a special case<sup>xxi</sup> given the relatively low baseline noise levels and therefore the sensitivity of this section of the footpath within the AONB. The magnitude of impact and the proportion of the footpath affected by perceptible noise increases is assessed as a direct permanent likely significant adverse effect on parts of this section of the Gloucestershire Way<sup>xxii</sup> between the Air Balloon roundabout and Coberley to the east, specifically on footpath links: ACO16, ACY3, ACO3 and ACO18. The adjoining footpath ACO15 would also be similarly affected. ACO17, to the north of ACO3 would be affected by perceptible change for only a small proportion of its length and the effect is assessed as not significant on this link.
- 11.10.98 Further south, footpath ACY44 (see Figure 11.4) on the east side of Barrow Wake runs south-east to join with the lane just north of Stockwell. At the Stockwell end of this footpath link, the easternmost 250m section would be affected by perceptible noise increases of more than 3dB(A). However, the north-western kilometre of this footpath link would be subject to smaller noise increases or reductions. Given the relatively small length of this footpath adversely affected as a proportion of the whole link, this is assessed as not significant.
- 11.10.99 On the east side of the lane through Stockwell, two footpaths (ACY26 and ACY22) connect to a lane approximately one kilometre to the south-east. The northernmost of these footpaths (ACY26) would align closely with the proposed

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<sup>xx</sup> GCC PRoW reference number.

<sup>xxi</sup> See assessment criteria – paragraph 11.5.57

<sup>xxii</sup> The Gloucestershire Way would be realigned at the western end of this section described in paragraph 11.10.96. The assessment takes this realignment into account.



scheme along most of the length of this link and would therefore be subject to noise increases of approximately 5-10dB(A). The southernmost footpath (ACY22) would be adversely affected for a relatively short proportion of its length. A third footpath in this area (section ACY36 and ACY27) runs from the lane at a point just north of Stockwell towards Green Hatch Farm to the north-east where it re-joins the same lane. This footpath would cross the proposed scheme and noise levels would be increased by 3dB(A) or more along the whole length of this link. These sections of footpath are considered in this assessment to be a special case given the relatively low baseline noise levels and therefore their sensitivity within the AONB. The footpath links ACY26, ACY36 and ACY27 are assessed as being subject to direct permanent likely significant adverse effects.

#### *Noise important areas*

- 11.10.100 There are six NIAs that lie within the A417 study area. However, NIA 3908 (Woodside House) would be removed as part of the scheme proposals. All these areas represent properties which are currently exposed to noise levels above the SOAEL. Of these, NIA 13915 (No.1 and 2 Air Balloon Cottages) and NIA 3905 (Castle Hill Cottage) will be subject to direct permanent likely significant beneficial effects. NIA 13196 (Laurel Cottage) would be subject to a negligible noise decrease.
- 11.10.101 With the proposed mitigation (noise screening – see Table 11-17), NIA 3906 (Crickley Court Cottages) and NIA 3907 (Fernbank) would be subject to direct permanent likely significant beneficial effects.

#### *Mitigation*

- 11.10.102 Operational mitigation measures included in the proposed scheme design are discussed in section 11.9 and listed in Table 11-17. This mitigation (mainly earth bunding) would be effective in avoiding or minimising the extent of significant noise effects around the proposed new alignment. This is also a cost-effective solution, as the spoil can be transferred from the excavation works to elsewhere on the site during scheme construction, notably from the deep cutting section to where the bunds are to be constructed. It will also avoid the sustainability and cost implications of moving material off-site.
- 11.10.103 As previously mentioned in paragraph 11.10.95, a number of PRoW to the south of Birdlip would realise beneficial noise impacts, although these benefits are as a direct result of the proposed A417 re-alignment and scheme design (which moves the noise source further away from these paths).
- 11.10.104 Effects of the new alignment close to PRoW would be minimised as a result of the noise bunding incorporated into the scheme design. This is most effective for sections of PRoW close to the scheme, but the attenuating effect reduces with greater distance from the bunding.
- 11.10.105 Apart from the visual mitigation of the proposed scheme provided by the bunding, the requirement for noise screening as part of bunding design was expressed by stakeholders during consultation events and written submissions. Hence it is expected that benefits would be perceived by stakeholders in relation to the combined visual and noise mitigation (the likelihood of perceived benefit is a mitigation criterion in LA 111). The mitigation design also responds to the requirements of the NPSNN to recognise that excessive noise can impact on the ‘...use and enjoyment of areas of value (such as quiet places) and areas with high landscape quality’, such as an AONB (refer to Table 11-1, NPSNN para 5.186).

11.10.106 On the western part of the proposed scheme (Brockworth bypass) the proposed environmental barriers are primarily located in Noise Important Areas (NIAs) to avoid impacts in residential locations designated as currently being subject to relatively high traffic noise exposures. The proposed noise mitigation at these locations addresses the requirement in the Defra Noise Action Plan: 'Roads (Environmental Noise (England) Regulations 2006, published 2 July 2019)' to identify proposed actions that will meet the vision and aims set out in the Government's policy on noise. The Regulations require that Action Plans should "apply in particular to the most important areas as established by the strategic noise maps (Regulation 15 (1)(e))". The benefits of the noise mitigation at the NIAs is described in paragraph 11.10.100.

#### *Noise insulation eligibility*

11.10.107 There are seven dwellings that would exceed the criteria to be eligible for noise insulation under the Noise Insulation Regulations. LA 111 (Annex E/2) requires that potential noise insulation eligibility is considered as part of the assessment. These are Crickley Hill Farm, Crickley Hill Farm Cottage, The Willows (Crickley Hill), The Flat (The Willows), Flat Willows, The Spinney, and The Willows (Badgeworth).

#### *Assessment of areas within 50m of other non-scheme road links with potential to experience short-term BNL change of more than 1dB*

11.10.108 LA 111 requires consideration of impacts on noise sensitive receptors alongside non-scheme road links not covered by the main study area. For these other road links, the calculations of noise level change are carried out within 50m of road links where there is a possibility of change of  $1\text{dB}_{\text{LA10,18hr}}$  or more in the short-term, or  $3\text{dB}_{\text{LA10,18hr}}$  in the long-term.

11.10.109 There are 31 road links in the short-term and five road links in the long-term that meet these traffic flow change thresholds. LA 111 requires noise sensitive receptors within 50m of these road links to be reported. In the long-term, there are 91 noise sensitive properties within 50m of the road links with a noise decrease which has a minor impact and a significant beneficial indirect effect. There is one noise sensitive property with a noise increase of minor impact, and therefore assessed as an indirect permanent likely significant adverse effect.

11.10.110 Table 11-24 summarises these results.

**Table 11-24 Noise changes at properties within 50m of other non-scheme roads**

Road	Noise increase or decrease	Number of noise sensitive receptors within 50m of the road link	Assessment
Gloucester Road, passes south-west of the village of Stratton	Increase	87	There is a short-term noise increase of around 1dB(A) on the Gloucester road link, near to Stratton. In the long-term the noise increase is around 1dB(A) (not significant).
London Road, near to Corinium Gate, north Cirencester	Increase	9	There is a noise increase of less than 2dB(A) in the short-term and long-term (not significant).



Road	Noise increase or decrease	Number of noise sensitive receptors within 50m of the road link	Assessment
Slad Road, Lansdown, Stroud	Increase	352	There is a short-term noise increase of approximately 1dB(A) on the Slad Road link in the Lansdown area of Stroud. In the long-term, the noise increase is less than 2dB(A) (not significant).
Slad Road, north Slad	Increase	49	There is a short-term noise increase of around 1dB(A) on the Slad Road link in the north of Slad. In the long-term, the noise increase is less than 2dB(A) (not significant).
Road passing through the village of Elkstone	Decrease	24	In the short-term, there is a decrease of approximately 3dB(A). In the long-term, the noise decrease is approximately 4dB(A). This is classed as a minor impact (significant beneficial indirect effect).
A435, south of the village of Colesbourne, near to Marsden Manor Road	Decrease	10	In the short-term, there is a decrease of approximately 1dB(A). No change for the long-term (not significant).
Cirencester Road, Painswick Road, Ermin Way and Birdlip hill	Decrease	66	In the short-term, there is a decrease of approximately 3-5dB(A). In the long-term, the noise decrease is approximately 3-4 dB(A). This is classed as a minor impact (significant beneficial indirect effect).
Leckhampton Hill	Increase	15	There is a short-term noise increase of around 1dB(A). In the long-term, the noise increase is less than 2dB(A) (not significant).
A436 and A435 pass through Seven Springs	Decrease	4	In the short-term, there is a decrease of approximately 1-2 dB(A). In the long-term, the noise decrease is below 2 dB(A) (not significant).
A435 (Cirencester Road) between the west of Charlton Kings and Seven Springs	Decrease	252	In the short term, there is a decrease of approximately 2 dB(A). In the long-term, the noise decrease is 2 dB(A) or below (not significant).
Leckhampton Road and Old Bath Road in the village of Pilley	Increase	534	There is a short-term noise increase of 1-2 dB(A). In the long-term, the noise increase is 2dB(A) or below (not significant).
A436, east of the village Kilkenny and north of the village Foxcote	Decrease	3	In the short-term, there is a decrease of just over 1dB(A). In the long-term, the noise decrease is less than 1dB(A) (not significant).
A40 (Gloucester Road), through the roundabout of A40 and B4063	Increase	1	In the short-term, there is an increase of less than 1 dB(A). In the long-term, the noise increase is below 5 dB(A). This is classed as a minor impact (significant adverse indirect effect).

Road	Noise increase or decrease	Number of noise sensitive receptors within 50m of the road link	Assessment
M5, next to Bamfurlong Lane	Decrease	1	In the short term, there is a decrease of less than 1dB(A). In the long-term, the noise decrease is around 4dB(A). This is classed as a minor impact (significant beneficial indirect effect).
B4058 and New Road passing through the village of Wotton-under-Edge	Increase	105	There is a short-term noise increase of approximately 1dB(A). In the long-term, the noise increase is approximately 1dB(A) (not significant).

11.10.111 The section of concrete-surfaced road on the A417/A419 over ten kilometres south of the proposed scheme<sup>xxiii</sup> was included in the above analysis of traffic changes associated with the A417 Missing Link scheme. For this concrete section of road, the short-term noise change would be less than 1dB(A), and less than 3dB(A) in the long-term (hence not included in the above table). This is assessed as a not significant change based on LA 111 assessment criteria.

*Compliance against the three aims of Government policy (NPSNN)*

11.10.112 The Government policy objectives (see paragraph 11.3.3) are also defined in the England National Application Annex to LA 111. In accordance with the assessment requirements, the proposed scheme's compliance against these objectives is set out in Table 11-25.

**Table 11-25 Proposed scheme compliance with Government policy**

Government policy objective (NPSNN)	Compliance with policy requirements
<p><b>Aim 1:</b> Avoid significant adverse impacts on health and quality of life from noise as a result of the new development. (NPSE describes this aim in relation to impacts above the SOAEL)</p>	<p>Significant adverse impacts from construction noise and vibration would be avoided through construction BPM mitigation, and noise insulation where established thresholds are exceeded. These controls would follow the principles and processes set out in the EMP (to be submitted as part of the DCO application).</p> <p>Some residual significant adverse effects are reported in this assessment for construction noise, despite the proposed mitigation measures – however all appropriate measures have been applied in these cases as far as it is practicable and sustainable to do so (see paragraphs 11.10.50- 11.10.53). Further mitigation, as far as is practicable and sustainable, would be detailed as required in the EMP following dialogue with local authorities.</p> <p>For operational noise, there are two properties where significant adverse impacts above the SOAEL are predicted to occur. Screening measures have been investigated in these cases but are not considered sufficiently effective to practicably and sustainably</p>

<sup>xxiii</sup> The potential for impacts has been raised during consultation for this section of road by local residents (i.e. *The campaign to have the concrete section of the A419/A417 resurfaced*).

	<p>mitigate the impact, Hence, these properties would exceed the criteria to be eligible for noise insulation under the Noise Insulation Regulations.</p> <p>For all other properties, effects above the SOAEL have been avoided by scheme mitigation design. This includes scheme alignment, lower noise road surface and noise screening.</p>
<p><b>Aim 2:</b> Mitigate and minimise other adverse impacts on health and quality of life from noise from the new development. (NPSE describes this aim in relation to impacts between the LOAEL and SOAEL)</p>	<p>Adverse impacts from construction noise and vibration would be mitigated and minimised through construction BPM mitigation. These controls would follow the principles and processes set out in the EMP (to be submitted as part of the DCO application).</p> <p>Adverse impacts from operational noise would be avoided by scheme alignment, and incorporated mitigation including lower noise road surface and noise screening.</p> <p>Some residual significant adverse effects for operational noise between the LOAEL and SOAEL are reported in this assessment despite the proposed mitigation measures. However, all appropriate measures have been applied in these cases as far as it is practicable and sustainable to do so to mitigate and minimise these effects.</p>
<p><b>Aim 3:</b> Contribute to improvements to health and quality of life through the effective management and control of noise, where possible. (Applies to all noise levels)</p>	<p>Noise mitigation measures described above have been incorporated to reduce noise levels. Beneficial effects would occur at communities and outdoor amenity areas. Noise levels would also be reduced at properties in the Noise Important Areas (see paragraphs 11.10.100-11.10.101).</p>

## 11.11 Monitoring

- 11.11.1 The requirements of LA 111 regarding monitoring and evaluation would be followed. The prediction and assessment methodologies set out in section 11.4 of this chapter would be used to support the verification of the effectiveness of any mitigation measures<sup>xxiv</sup>. Monitoring of the effectiveness would be carried out as part of Highways England's Project Evaluation procedures, which evaluates how highway schemes are delivered and would highlight any issues with meeting the accepted design.
- 11.11.2 Where access is required onto private land for monitoring purposes, prior consultation would be undertaken with the occupier and appropriate arrangements would be made to enable the monitoring to be undertaken.
- 11.11.3 Highways England has a duty under Regulation 6 of the NIR to assess noise levels following the opening of the scheme to traffic. The purpose of this is to establish the buildings previously not identified as qualifying for an original offer of carrying out or making a grant in respect of carrying out noise insulation work, which may have become eligible by increased traffic flow. Assessments would be carried out in accordance with the obligations set out in the NIR.

<sup>xxiv</sup> Refer to: Table 11-17 Incorporated noise mitigation measures for operation of the scheme

## 11.12 Summary

- 11.12.1 Construction and operational traffic noise have been assessed in terms of Government Policy (for dwellings potentially exceeding the SOAEL), and Environmental Impact Assessment significance (between the LOAEL and SOAEL). These different types of effect are explained in Table 11-3.

### Construction assessment

- 11.12.2 Construction noise and vibration has been assessed from the available construction information at the time of preparation of the ES. The assessment assumes that the works would be undertaken following the principles, controls and processes set out in the EMP (which will be produced and submitted as part of the DCO application).
- 11.12.3 The principal activities considered with the potential to cause noise and vibration effects are excavation and earthworks to the area of embankment and cutting between approximate chainages 0+800 to 2+800. This is likely to be where the most intensive work will be carried out for the longest duration, i.e. topsoil strip and earthworks cut and fill (including haul roads), and surface levelling prior to pavement laying.
- 11.12.4 Night-time activities would be strictly limited to those activities that could not be completed without road closures. Primarily this will be installing and removing traffic management at junction tie-ins.

### Significant effects

- 11.12.5 Direct temporary likely significant adverse construction noise effects have been assessed at 14 residential properties during the daytime only (see Table 11-18). These are direct effects above the SOAEL threshold, as described in Government Policy. The properties are represented by the following receptors (all construction receptors are shown in Figure 11.1):
- R2 Fernbank (7);
  - R3 Crickley Ridge (2);
  - R4 Air Balloon Cottages (2)
  - R6 Rushwood Kennels; and
  - R12 Shab Hill Farm (2).
- 11.12.6 Likely daytime noise impacts are also assessed as direct temporary significant adverse effects at a number of non-residential receptors, represented by the following receptor locations:
- Receptor R5 Birdlip Radio Station;
  - Receptor R6 Rushwood Kennels and Cattery
  - PRoWs within approximately 500m of major excavation works; and
  - R16 Emma's Grove scheduled monument.

### Non-significant effects

- 11.12.7 Night-time activities are predicted to give rise to minor, moderate or major adverse impacts at residential properties for only a limited number of nights and are therefore considered to be not significant. The results are shown in Table 11-19.

- 11.12.8 Construction traffic using off-site haul roads is predicted to give rise to negligible noise increases on the A417 or other major roads leading to or from the site to the north and south of the proposed scheme.
- 11.12.9 Diversion routes used at night will cause temporary major impacts at over 1,000 residential properties. However, diversions at night will be used on a limited number of occasions, sporadically and therefore will not constitute a significant effect.
- 11.12.10 It is likely that construction vibration levels generated by road surfacing activities at receptor locations close to the proposed scheme would result in moderate adverse impacts above a SOAEL. However, the duration of these impacts is estimated to be less than ten days, hence these effects are assessed as not significant based on the LA 111 assessment criteria (paragraph 11.4.37).

### **Operational assessment**

- 11.12.11 Incorporated mitigation has been included in the proposed scheme design to avoid significant adverse noise effects, and to minimise, as far as practicable and sustainable, adverse noise effects from the scheme.
- 11.12.12 Daytime and night-time traffic noise levels within the study area (see Figures 11.1-11.4) have been predicted and are assessed in terms of:
- Residential receptors exceeding the SOAEL;
  - Residential receptors between the LOAEL and SOAEL; and
  - Non-residential receptors.

#### Residential receptors exceeding the SOAEL

- 11.12.13 Crickley Hill Farm and Crickley Hill Farm Cottage are predicted to experience direct adverse effects from increased noise levels in the short term. This refers to a direct effect where there is at least a 1dB(A) impact as a result of the proposed scheme. These increases are assessed as direct permanent likely significant adverse effects.
- 11.12.14 Five dwellings that would already exceed the SOAEL in the baseline year in the absence of the proposed scheme, would be subject to negligible noise reductions with the scheme. These are The Lodge, Gillsland Cottage, Cottage on Ridge, 6 and 7 Ivy Lodge Barns.
- 11.12.15 Five locations currently exceeding the SOAEL would be subject to larger than negligible noise reductions as a result of the proposed scheme. These are No 1 and No 2 Air Balloon Cottages, Crickley Court, Halfacres and Fernbank. For a further twelve dwellings, noise levels would reduce such that the noise exposure would fall below the SOAEL with the scheme in operation. All the above noise reductions would be greater than 1dB(A) and because the baseline noise level would be above the SOAEL, these reductions are assessed as direct permanent likely significant beneficial effects.
- 11.12.16 A further seven properties currently exceeding the SOAEL would be subject to indirect permanent likely significant beneficial effects as a result of changes in road traffic noise associated with non-scheme roads. These are No.1 and 2 Oxford Cottages, Crendan House, Mosella Cottage, The Grove, Old Ullenwood Lodge, and Laurel Cottage.

### Residential receptors between LOAEL and SOAEL

- 11.12.17 Twenty dwellings are assessed as being subject to direct permanent likely significant adverse effects between the LOAEL and SOAEL.
- 11.12.18 There are 27 dwellings that would be subject to direct permanent likely significant beneficial effects between the LOAEL and SOAEL. These dwellings are all located near the existing alignment south of the Air Balloon roundabout where the existing highway would be removed.
- 11.12.19 There are nine dwellings subject to beneficial noise reductions as a result of changes in road traffic noise associated with non-scheme roads. These are The Dower House, Barn (Hill Farm), High Ridge, Knapp House, Knapp Cottage, The Knapp Lodge, Flat at Green Dragon, Ridge Cottage and Blackhorse Ridge. These are assessed as indirect permanent likely significant beneficial effects.

### Noise Important Areas (NIAs)

- 11.12.20 Two existing Noise Important Areas (NIAs) would have been subject to additional noise increases of 1dB or more as a direct result of the proposed scheme, where existing noise levels currently already exceed the SOAEL. To address this, incorporated noise mitigation has been included to reduce noise to below those levels without the scheme.
- 11.12.21 Specifically, these NIAs are at Fernbank (3907) and Crickley Court (3906) located west of the Air Balloon roundabout alongside the proposed scheme. These reductions are assessed as direct permanent likely significant beneficial effects.

### Non-residential receptors

- 11.12.22 For non-residential sensitive receptors, several receptors have been identified to represent key, sensitive locations within the AONB that would be most affected by the proposed scheme.
- 11.12.23 At Crickley Hill Country Park, 'The Scrubbs' area and footpaths on the escarpment rising up to the Country Park would be subject to reductions in traffic noise exposure, particularly at the lower part of the hill closer to the removed section of highway. The magnitude and spatial extent of the noise reduction across this part of the County Park (designated site - SSSI, SAM) and footpaths here is assessed as not significant.
- 11.12.24 South of the Air Balloon roundabout, the removal of the existing highway would result in noise reductions in this area and along the Cotswold Way. The section of the footpath between Air Balloon roundabout and Barrow Wake view point car park (where it joins the new link roundabout with the re-aligned B4070) would be subject to a direct likely significant beneficial effect. Further south, the section of footpath from just north of Birdlip, running east across the removed road and turning south to Parson's Pitch would also be subject to a direct permanent likely significant beneficial effect.
- 11.12.25 To the south-east of the Air Balloon roundabout, the new alignment would result in noise increases around the proposed scheme. The noise increase is assessed as a direct permanent likely significant adverse effect on the section of the Gloucestershire Way between the Air Balloon roundabout and Coberley to the east. This section of the footpath is considered in this assessment to be a unique

feature given the relatively low baseline noise levels and therefore the sensitivity of this section of the footpath within the AONB.

- 11.12.26 On the east side of the lane through Stockwell there are three footpaths connected to the lane (immediately north of Stockwell). All these footpath links run for approximately one kilometre to the east. These footpath links are assessed as unique features in this part of the AONB where baseline noise levels are low and are assessed as being subject to a direct permanent likely significant adverse effect.

### **Compliance against the three aims of Government policy (NPSNN)**

- 11.12.27 Compliance with Government policy objectives (defined in the England National Application Annex to LA 111) has been achieved by mitigation design. Mitigation design would result in noise reductions at residential communities, outdoor amenity areas and Noise Important Areas. Where significant adverse effects would remain, all appropriate measures have been applied as far as it is practicable and sustainable to do so to avoid, mitigate and minimise these effects.

### **Further work**

- 11.12.28 As part of the EIA, the operational assessment will be updated with any changes to the proposed scheme resulting from consultation.



## End Notes & References

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<sup>1</sup> Highways England, Transport Scotland, Welsh Government, and Department for Infrastructure Northern Ireland, “Design Manual for Roads and Bridges LA 111, Noise and Vibration, Revision 0, TSO,” 2019

<sup>2</sup> Department for Environment Food & Rural Affairs, “Noise Policy Statement for England (NPSE),” 2010.

<sup>3</sup> Ministry of Housing Communities and Local Government, “National Planning Policy Framework,” 2019

<sup>4</sup> Ministry of Housing Communities and Local Government, “Planning Practice Guidance – Noise,” 2014 (updated 2019). [Online]. Available: <https://www.gov.uk/guidance/noise--2>. [Accessed: 19-Nov-2019]

<sup>5</sup> Department for Transport, “National Policy Statement for National Networks,” London, 2014.

<sup>6</sup> Cotswold District Council, “The Cotswold District Local Plan (2011-2031),” Cirencester, 2018 <https://www.cotswold.gov.uk/media/1621895/Cotswold-District-Local-Plan-2011-2031-Adopted-3-August-2018-Web-Version.pdf>

<sup>7</sup> Gloucester City Council, Cheltenham Borough Council, and Tewkesbury Borough Council, “Joint Core Strategy 2011-2031,” no. November, 2017 <https://www.jointcorestrategy.org/>

<sup>8</sup> Tewkesbury Borough Council, “Pre-submission Tewksbury Borough Plan,” 2019 <https://minutes.tewkesbury.gov.uk/documents/s23896/Borough%20Plan%20Document.pdf>

<sup>9</sup> Cotswolds Conservation Board, “Cotswolds AONB Management Plan 2018- 2023,” 2018 <https://www.cotswold.gov.uk/media/1547669/NS027-Cotswolds-AONB-management-plan-2013-18-adopted-pre-publication.pdf>

<sup>10</sup> Cotswolds Conservation Board, “Cotswolds AONB National Park Position Statement,” 2018 <https://www.cotswoldsaonb.org.uk/our-landscape/position-statements-2/>

<sup>11</sup> Cotswolds Conservation Board, “Cotswolds AONB Position Statement Dark Skies and Artificial Light,” 2019. <https://www.cotswoldsaonb.org.uk/wp-content/uploads/2019/03/Cotswolds-Dark-Skies-Artificial-Light-Position-Statement.pdf>

<sup>12</sup> Cotswolds Conservation Board, “Development in the setting of the Cotswolds AONB,” 2016 <https://www.cotswoldsaonb.org.uk/wp-content/uploads/2017/08/setting-position-statement-2016-adopted-with-minor-changes-30616-1.pdf>

<sup>13</sup> Cotswolds Conservation Board, “Cotswolds AONB Public Rights of Way Position Statement,” 2015 <https://www.cotswoldsaonb.org.uk/wp-content/uploads/2017/08/public-rights-of-way.pdf>

<sup>14</sup> Cotswolds Conservation Board, “Cotswolds AONB Tranquillity Position Statement,” 2019 <https://www.cotswoldsaonb.org.uk/wp-content/uploads/2019/06/Tranquillity-Position-Statement-FINAL-June-2019.pdf>

<sup>15</sup> Environmental Noise Directive, 2002/49/EC, 2002.

<sup>16</sup> BS5228-1:2009+A1:2014, *Code of practice for noise and vibration control on construction and open sites – Noise*, 2014

<sup>17</sup> Department of Transport and Welsh Office, “Calculation of Road Traffic Noise”, 1998.

<sup>18</sup> Highways England, Transport Scotland, Welsh Government, and Department for Infrastructure Northern Ireland, “Design Manual for Roads and Bridges LA 104 Environmental assessment and monitoring,” 2019

<sup>19</sup> Department for Transport, WebTAG, May 2019 [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/825064/tag-unit-a3-environmental-impact-appraisal.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/825064/tag-unit-a3-environmental-impact-appraisal.pdf)

<sup>20</sup> Noise Insulation Regulations (as amended 1988), 1975.

<sup>21</sup> Abbott, PG & Nelson PM (2002), PR/SE/451/02, Converting the UK traffic noise index  $L_{A10,18h}$  to EU noise indices for noise mapping, TRL

<sup>22</sup> UK Government, “Open data: strategic noise mapping,” 2012. [Online]. Available: <https://www.gov.uk/government/publications/open-data-strategic-noise-mapping>. [Accessed: 19-Nov-2019]

<sup>23</sup> BS5228-2:2009+A1:2014, *Code of practice for noise and vibration control on construction and open sites – Vibration*, 2014



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<sup>24</sup> BSI, BS 7385: *Evaluation and measurement for vibration in buildings – Guide to damage levels from groundborne vibration* 1993.

<sup>25</sup> BSI, BS ISO 4866:2010 *Mechanical vibration and shock – Vibration of fixed structures – Guidelines for the measurement of vibrations and evaluation of their effects on structures* 2010

<sup>26</sup> World Health Organization, “Guidelines for community noise,” 1999.

<sup>27</sup> World Health Organization, “Night Noise Guidelines For Europe,” Copenhagen, 2009

<sup>28</sup> World Health Organization, “Environmental Noise Guidelines for the European Region”, 2018

<sup>29</sup> Campaign to Protect Rural England (CPRE) Saving Tranquil Places: How to Protect and Promote a Vital Asset. 2006

<sup>30</sup> Cotswolds Conservation Board, “Cotswolds AONB Tranquility Position Statement,” 2019

<sup>31</sup> The Planning Inspectorate, “Scoping Opinion: Proposed A417 Missing Link,” 2019.

<sup>32</sup> UK Government, “Noise Action Planning Important Areas Round 2 England,” 2019. [Online]. Available: <https://data.gov.uk/dataset/fc786717-3756-4fd1-9c7d-c082331e40e4/noise-action-planning-important-areas-round-2-england>. [Accessed: 19-Nov-2019]