

M5 Junction 10 Improvements Scheme

Environmental Statement Chapter 6: Noise and Vibration TR010063 – APP 6.4

Regulation 5(2)(a)

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6.4 Environmental Statement: Chapter 6: Noise and Vibration

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Document accessibility

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6. Noise and Vibration

6.1. Introduction

- 6.1.1. This chapter presents the findings of the environmental assessment of the M5 Junction 10 Improvements Scheme (“the Scheme”) for Noise and Vibration based on the Scheme as it is described in Chapter 2 – The Scheme (application document TR010063 – APP 6.2) and detailed in the General Arrangement Plans (application document TR010063 – APP 2.9).
- 6.1.2. The chapter sets out the standards and methodologies that have been used to carry out the assessment of noise and vibration for the Environmental Statement. It contains information about the existing and the potential noise constraints and describes the potential noise and vibration impacts related to the construction and operation of the Scheme.
- 6.1.3. The chapter describes mitigation for both the construction and operation phase, assesses the residual and cumulative effects and provides details on NPS compliance.
- 6.1.4. The construction and operational noise assessments have been carried out in accordance with National Highways Design Manual for Roads and Bridges (DMRB) LA 111 ‘Noise and Vibration’ - 2020 Revision 2.

6.2. Competent expert evidence

- 6.2.1. This noise and vibration chapter has been undertaken by the following individual who has used their knowledge and professional judgement to undertake this assessment:
- A qualified acoustician (BSc, MSc, MIOA), who holds professional membership with the Institute of Acoustics. They have over 20 years of knowledge and experience in noise and vibration.

6.3. Planning policy and legislative context

- 6.3.1. This section provides details of the planning policy and legislation relevant to this topic. It should be noted that the details presented in this section are not intended to provide a full consideration of the relevant documents and their application to the Scheme. This information is provided within the Planning Statement and Schedule of Accordance with National Policy Statement (application document TR010063 – APP 7.1) that accompanies the application for a DCO.

National policy

- 6.3.2. Current noise policy in England is based on the Noise Policy Statement for England (NPSE), which through the effective management and control of environmental noise within the context of Government policy on sustainable development, aims to:
- Avoid significant adverse effects as a result of the Scheme.
 - Mitigate and minimise other adverse impacts on health and quality of life.
 - Contribute to improvements to health and quality of life, where possible.
- 6.3.3. The Scheme is intended to adhere to the aims of the NPSE. These aims are considered with reference to the guidance contained within the:
- National Policy Statement for National Networks (NPS NN) 2014.
 - National Planning Policy Framework (NPPF) 2021.
 - Planning Practice Guidance: Noise (PPGN) 2019.
- 6.3.4. The Explanatory Note to the NPSE assists in the definition of significant adverse and adverse with the following concepts:

- NOEL – no observed effect level. This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
- LOAEL – lowest observed adverse effect level. This is the level above which adverse effects on health and quality of life can be detected.
- SOAEL – significant observed adverse effect level. This is the level above which significant adverse effects on health and quality of life occur. The Government policy and guidance do not state values for the NOEL, LOAEL and SOAEL, rather, it considers that they are different for different noise sources, for different receptors and at different times and should be defined on a strategic or project basis taking into account the specific features of that area, source or project.

6.3.5. The NPS NN references the relevant sections of the Noise Policy Statement for England, National Planning Policy Framework and the Government’s associated planning guidance on noise.

6.3.6. It also states that “the project should demonstrate good design through optimisation of scheme layout to minimise noise emissions and, where possible, the use of landscaping, bunds or noise barriers to reduce noise transmission. The project should also consider the need for the mitigation of impacts elsewhere on the road and rail networks that have been identified as arising from the development, according to Government policy.”

Legislation

6.3.7. The Scheme will be designed to ensure compliance with relevant legislation relating to noise, with the following documents called upon as required:

- The Control of Pollution Act 1974.
- The Environmental Protection Act 1990.
- The Control of Noise (Code of Practice for Construction and Open Sites) (England) Order 2015.
- The Noise Insulation (Amendment) Regulations 1988.
- The Highways Noise Payments and Movable Homes (England) Regulations 2000.
- The Land Compensation Act 1973.
- The Environmental Noise (England) Regulations 2006.

6.3.8. The Control of Noise Order approves the British Standard BS 5228:2009+A1:2014 Part 1 Noise and Part 2 Vibration for the purpose of giving guidance on appropriate methods for minimising noise and vibration. In addition, BS 5228, which also references the three Acts listed above, provides the calculation and assessment methodology used within DMRB LA 111 to undertake the construction noise and vibration assessments.

6.3.9. The determination of eligibility, for insulation or grants, under the Noise Insulation Regulations is made using the Calculation of Road Traffic Noise, 1988 (CRTN), which is used to predict the noise from existing and potential future roads. CRTN is also the preferred noise calculation method. DMRB LA 111 includes modifications to CRTN which have been incorporated into the noise modelling software.

6.3.10. The Highways Noise Payments and Movable Homes Regulations has been included as caravans, park homes and houseboats do not qualify for noise insulation or grant under the Noise Insulation Regulations.

6.3.11. More details on the Policy and Legislation are found Table 6-34 of Appendix 6.1 (application document TR010063 – APP 6.15).

Regional and local policy

6.3.12. Cheltenham Borough Council (CBC) and Tewkesbury Borough Council (TBC) are the authorities responsible for noise and vibration in the area of the Scheme, through their Environmental Health teams.

6.3.13. The ‘Gloucester, Cheltenham and Tewkesbury Joint Core Strategy’ (JCS) 2011-2031 (December 2017) includes a policy relating to noise emissions. Policy SD4 of this document states:

- 6.3.14. “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.”
- 6.3.15. The JCS identifies larger sites for housing and employment and deals with strategic issues such as design and transport infrastructure. The local plans identify additional specific locations for smaller-scale growth and set out detailed policies for development and protecting key assets.
- 6.3.16. The Cheltenham Plan (2011-2031) does not include specific policies related to noise and vibration but does reference Policy SD4 of the JCS and the principles of good design embodied within. This includes “Policy SL1: Safe and Sustainable Living” from the Cheltenham Plan, plus the sections on Design Requirements, the Transport Network and, Social and Community Infrastructure.
- 6.3.17. The Tewkesbury Borough Plan (2011-2031) does not include specific policies related to noise, but does specifically reference Policy SD4 of the JCS within the Housing section of the plan, as well as general references to the JCS throughout the Plan.

Guidance on Health Effects

- 6.3.18. Environmental noise is an important health issue. In 2011 the Burden of Disease from Environmental Noise by World Health Organisation (WHO)¹ identified environmental noise as the second largest environmental risk to public health across Western Europe.
- 6.3.19. The WHO document ‘Environmental Noise Guidelines for the European Region’, 2018 and the Department for Environment, Food and Rural Affairs (Defra) ‘Environmental Noise: Valuing impacts on sleep disturbance, annoyance, hypertension, productivity and quiet’, 2014 (the Defra Guidance) have been used to reference the effect of noise on human health.
- 6.3.20. Both of these documents provide information about the potential impacts on amenity and health from transportation noise. The exposure to transportation noise can lead to various health effects.
- 6.3.21. The WHO Environmental Noise Guidelines, 2018 provide specific recommendations, such as the strong recommendation to reduce road traffic noise levels to below 53dB L_{den} and 45dB L_{night}, as well as to provide suitable intervention measures to reduce noise that exceeds these noise exposure values. They also provide the following Guiding Principles to:
- Reduce exposure to noise, while conserving quiet areas.
 - Promote interventions to reduce exposure to noise and improve health.
 - Coordinate approaches to control noise sources and other environmental health risks.
 - Inform and involve communities potentially affected by a change in noise exposure.
- 6.3.22. People appreciate quiet areas as beneficial for their health and well-being, especially by those affected by continuous noise exposure. These quiet areas play a role in improving creativity, problem solving, mental health, concentration and on undisturbed sleep. The Defra guidance indicated that the quality of a quiet area is linked to the audibility of natural sounds, where they are not masked by manmade sounds. In addition to sound, the visual appeal is also very important to the appreciation of quiet areas.
- 6.3.23. As stated in NPSE, the LOAEL and SOAEL values are related to adverse, and significant adverse, effects on health and quality of life respectively. LOAEL and SOAEL values have been provided for both the Construction and Operational assessments within the Methodology section.

¹ World Health Organization. Regional Office for Europe. (2011). Burden of disease from environmental noise: quantification of healthy life years lost in Europe. World Health Organization. Regional Office for Europe. <https://apps.who.int/iris/handle/10665/326424>

6.4. Methodology

Construction

- 6.4.1. The calculation of construction noise levels follows the methodology in BS 5228 Part 1. The predicted noise levels from construction noise sources have been compared against the assessment criteria shown in the DMRB LA 111. These assessment criteria are influenced by the existing baseline noise levels. Baseline noise levels have been ascertained using a combination of:
- Strategic noise mapping (Defra), Round 3 from 2017.
 - Predicted 'do minimum opening year' noise levels for 2027.
 - Baseline noise monitoring survey data gathered in 2021.
- 6.4.2. Noise sources considered during the assessment include:
- Construction plant in use during the construction of the Scheme
 - Construction compounds.
 - Construction traffic on haul roads that are not part of the public highway.
- 6.4.3. The details of the construction plant, including the activities being carried out, the number and types of plant being used, and the typical working hours were used to undertake this assessment. This information has been provided in Section 6.9 and Table 6-38 of Appendix 6.1 (application document TR010063 – APP 6.15).

Study Area

- 6.4.4. In accordance with DMRB LA 111, the study area for construction noise has been defined to include all noise sensitive receptors that are potentially affected by construction noise and in areas where there is a reasonable stakeholder expectation that a construction noise assessment will be undertaken.
- 6.4.5. DMRB LA 111 states that a study area of 300m from the closest construction activity is normally sufficient to encompass noise sensitive receptors. The construction activity noise study area has been determined to be 300m from the Order limits, which is sufficient to capture the shortest distance from a property to the construction activities, where 300m or less.
- 6.4.6. The study area for vibration from construction activity was defined to include all vibration sensitive properties that are potentially affected by construction vibration and where there is a reasonable stakeholder expectation that a construction vibration assessment will be undertaken.
- 6.4.7. DMRB LA 111 states that a study area of 100m from the closest construction activities with the potential to generate vibration is normally sufficient to encompass vibration sensitive receptors. The construction vibration study area has been determined to be 100m from the Order limits, which is sufficient to capture the shortest distance from a property to the construction activities, where 100m or less.
- 6.4.8. In addition, the DMRB LA 111 determined that 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.
- 6.4.9. Three nights of M5 closures are expected during the installation of the two new bridge decks, and removal of the existing A4019 overbridge. Closure of the two slip roads at Junction 10 will be longer, at 15 months for the northbound on slip and 9 months for the southbound off slip, with an overlap of 5 months when both slip roads are closed. The diversion routes study area was defined to be 25m from the kerb line of the diversion route.
- 6.4.10. The construction traffic study area was defined to include all noise sensitive receptors located within 50m from the kerb of public roads with the potential for an increase in basic noise level of 1dB $L_{A10,18h}$ or more as a result of the addition of construction traffic to existing traffic levels.

Determination of significance - Noise

- 6.4.11. The LOAEL, which represents the lowest noise level at which the detectable onset of an adverse effect can occur, was set to be equal to the baseline noise levels as per the DMRB LA 111. The value of the LOAEL/baseline noise level was then used to select an appropriate SOAEL; a value that if exceeded has the potential to result in a significant effect depending on duration and context.
- 6.4.12. The corresponding SOAEL values for each of the selected representative noise sensitive receptors were determined using the ABC method outlined in BS 5228 Part 1 (and reproduced in the DMRB LA 111). The ABC method requires the baseline noise level (the LOAEL) to be rounded to the nearest 5dB and compared against the Category A values shown in Table 6-1 for the time period of interest. The SOAEL is selected depending on whether the rounded baseline noise level is below, equal to, or higher than the values shown in Category A, or higher than the values shown in Category C, as explained in the notes in Table 6-1.

Table 6-1 - The ABC method, BS 5228 Part 1

Assessment category and threshold value period	Threshold value, in decibels (dB) ($L_{Aeq,T}$) Category A ^{A)}	Threshold value, in decibels (dB) ($L_{Aeq,T}$) Category B ^{B)}	Threshold value, in decibels (dB) ($L_{Aeq,T}$) Category C ^{C)}
Night-time (23:00 - 07:00)	45	50	55
Evenings and weekends ^{D)}	55	60	65
Daytime (07:00 - 19:00) and Saturdays (07:00 - 13:00)	65	70	75

Note 1 A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.

Note 2 If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3dB due to site noise.

Note 3 Applied to residential receptors only.

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

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

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

D) 19:00-23:00 weekdays, 13:00-23:00 Saturdays and 07:00-23:00 Sundays.

- 6.4.13. Once the LOAEL and SOAEL values were identified, the magnitude of the potential impact from construction activity noise was then assessed using the information shown in Table 6-2. ‘Moderate’ and Major’ magnitudes of impact are considered to represent an exceedance of the threshold for a significant adverse effect (SOAEL). ‘Minor’ magnitudes of impact are considered to represent the threshold of an adverse effect (LOAEL), however construction noise may still be perceptible when predicted to be below the LOAEL.

Table 6-2 - Magnitude of impacts from construction activity noise and construction traffic

Magnitude of Impact	Construction Noise Level (L_{Aeq})
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

Source: Tables 3.16 DMRB LA 111

- 6.4.14. A significant effect attributed to construction vibration is likely where it is determined that a moderate or major magnitude of impact shall occur for:
- either 10 or more days or nights in any 15 consecutive days or nights; or
 - a total number of days exceeding 40 in any 6 consecutive months.

Determination of significance – Vibration

- 6.4.15. Vibration from construction activities has been predicted in accordance with the methodology found in BS 5228 Part 2, 'Code of practice for noise and vibration control on construction and open sites. Vibration' as prescribed by the DMRB LA 111. The significance of potential impacts have been ascertained using the methodology contained in DMRB LA 111 for the human perception of vibration, which takes into account the magnitude of the vibration and whether threshold levels for the LOAEL or SOAEL are exceeded. Table 6-4 below shows the construction vibration LOAEL and SOAEL values determined by DMRB LA 111.

Table 6-3 - Construction vibration LOAELs and SOAELs for all receptors

Threshold level	Vibration level (PPV) ¹	Effect ²
LOAEL	0.3 mm/s	Vibration might be just perceptible in residential environments
SOAEL	1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation is given to the residents

¹ Threshold levels for LOAEL and SOAEL stated in DMRB LA 111, Table 3.31.
² Vibration perceptibility stated in BS 5228 Part 2, Table B.1.

- 6.4.16. To assess the magnitude of impact of construction vibration reference is made to DMRB LA 111, Table 3.33. This is reproduced below in Table 6-4. 'Moderate' and 'Major' magnitudes of impact are considered to represent an exceedance of the threshold for a significant adverse effect (SOAEL). 'Minor' magnitudes of impact are considered to represent the threshold of an adverse effect (LOAEL), however construction vibration may still be perceptible when predicted to be below the LOAEL.

Table 6-4 - Magnitude of impact of vibration levels

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

Source: Table 3.33, DMRB LA 111

- 6.4.17. A significant effect attributed to construction vibration is likely where it is determined that a moderate or major magnitude of impact shall occur for:
- either 10 or more days or nights in any 15 consecutive days or nights; or
 - a total number of days exceeding 40 in any 6 consecutive months.
- 6.4.18. Where high levels of vibration are predicted, the values in Table 6-5 are used to determine the potential for cosmetic damage to buildings.

Table 6-5 - Guidance on the effects of vibration levels perceptible to buildings

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

Source: Table B.2, BS 5228 Part 2

Determination of significance – Diversion traffic

- 6.4.19. The M5 and A4019 will remain operational for the majority of the construction of the Scheme. The closure of the M5 will be required when the two new bridge decks are being positioned at the junction, and the existing A4019 overbridge is demolished. It is expected that the closure would take approximately twelve hours for each structure and would happen overnight, limiting the diversion of motorway traffic onto the local road network.
- 6.4.20. Closure of the two slip roads at Junction 10 will be longer, for 15 months for the northbound on slip and 9 months for the southbound off slip, with an overlap of 5 months when both slip roads are closed. The diversion route for traffic seeking to join the M5 at Junction 10 and travel northbound, will be via the A38 and A46 to Junction 9. The diversion route for traffic southbound on the M5, and seeking to leave the M5 at Junction 10, will be to Junction 11, and then the A40 and A4013.
- 6.4.21. In accordance with DMRB LA 111, a proportionate approach has been undertaken to determine the likelihood of a significant effect during the night-time closure of the M5, where the sudden change of traffic levels on diversion routes, as a result of night-time closures, is highly likely to cause disturbance to receptors within 25m of the road.
- 6.4.22. Plus, potential noise impacts from diversion traffic were considered to constitute a significant effect where a major or moderate magnitude of impact was predicted for a duration exceeding:
- 10 or more days or nights in any 15 consecutive days or nights, or
 - A total number of days exceeding 40 in any 6 consecutive months.
- 6.4.23. The change in noise due to the diversion of M5 traffic onto local roads is highly likely to cause disturbance, however the duration criteria would not be met during the bridge closures. This is not considered to be a significant effect.
- 6.4.24. DMRB LA 111 specifies that the proportionate approach is used when a project requires full carriageway closures. As less than 10% of the M5 traffic use each of the slip roads, and a simple comparison of traffic data has been carried out to determine the impact of the M5 Junction 10 slip road closures on the diversion routes.
- 6.4.25. A sensitivity assessment has been undertaken to understand the likely traffic impacts arising from the changes to the access of the M5 at J10 via the slip roads. A traffic modelling scenario has been developed that reassigns the traffic seeking to join the M5 at J10 to travel northbound; and southbound traffic seeking to exit the M5 at J10.
- 6.4.26. The changes in 'basic noise level' (BNL) due to diversion traffic were calculated for roads within the diversion traffic study area using the methodology found in CRTN. When the traffic flows were low, and outside the validity of the CRTN calculation methodology, the BNL was calculated using the Noise Advisory Council's "Guide to Measurement and Prediction of the Equivalent Continuous Sound Level L_{eq} " (1978).

6.4.27. Traffic data used in this assessment has been speed pivoted to ensure that modelled speeds from the traffic model are consistent with observed speeds, in accordance with DMRB LA 111. The traffic data contains the following components;

- 18-hour annual average weekday traffic (AAWT) flow.
- 18-hour average speed (kph).
- Percentage Heavy Duty Vehicles (HDV) content of total 18-hour AAWT flow.

6.4.28. The impact magnitude of changes in noise due to construction traffic on receptors provided in the DMRB LA 111 is shown in Table 6-6 below, which is appropriate for use with the diversion routes.

Table 6-6 - Magnitude of impact from construction traffic at receptors

Magnitude of Impact	Change in Construction Traffic Noise Level (L _{A10,18h})
Major	Greater than or equal to 5dB
Moderate	Greater than or equal to 3dB and less than 5dB
Minor	Greater than or equal to 1dB and less than 3dB
Negligible	Less than 1dB

Source: Tables 3.17 DMRB LA 111

Determination of significance – Construction traffic

6.4.29. Construction traffic includes the movement of all plant, material and the construction workforce during the construction period, and does not include diversion routes.

6.4.30. Changes in 'basic noise level' (BNL) due to construction traffic were calculated for roads within the construction traffic study area using the methodology found in CRTN.

6.4.31. Traffic data used in this assessment has been speed pivoted to ensure that modelled speeds from the traffic model are consistent with observed speeds, in accordance with DMRB LA 111. The traffic data contains the following components;

- 18-hour annual average weekday traffic (AAWT) flow.
- 18-hour average speed (kph).
- Percentage Heavy Duty Vehicles (HDV) content of total 18-hour AAWT flow.

6.4.32. The impact magnitude of changes in noise due to construction traffic on receptors provided in the DMRB LA 111 is shown in Table 6-6 above.

6.4.33. In accordance with the DMRB LA 111, potential noise impacts from construction traffic were considered to constitute a significant effect where a major or moderate magnitude of impact was predicted for a duration exceeding:

- 10 or more days or nights in any 15 consecutive days or nights, or
- A total number of days exceeding 40 in any 6 consecutive months.

6.4.34. A review of the construction traffic data supplied by the project team, showed that BNL on existing roads would not increase by 1dB or more. Consequently, all changes in noise level across the planned construction routes are negligible and no detailed assessment is required. However, given the increase in HDV on the road network, the change in characteristics of noise may be perceptible.

6.4.35. In addition to changes on existing roads, there will be a new haul road for the West Cheltenham Link Road (“the Link Road”), which will be assessed as part of the Construction activity noise assessment.

Operation

6.4.36. The Scheme has the potential to affect road traffic noise levels at noise sensitive receptors caused by changes to the following:

- Road alignment (vertical and horizontal), including the addition of new or bypassed roads.

- Sound generation (traffic flow, speed, gradient and road surface type).
 - Sound propagation (ground absorption, screening, reflection, and scattering).
- 6.4.37. The Scheme's proposals do not include the introduction or alteration of any other sources of environmental noise, other than road traffic. The operational phase noise assessment was therefore focussed on impacts from road traffic noise only.
- 6.4.38. The noise assessment is carried out in line with DMRB LA 111, with predictions carried out using a 3D noise model of the study area, with and without the Scheme. The road traffic noise calculations are undertaken in accordance with the modified CRTN methodology set out in DMRB LA 111 Appendix A2.

Study Area

- 6.4.39. The operational phase road traffic noise study area was defined in accordance with the DMRB LA 111, which suggests that the study area should encompass the following:
- The area within 600m of new road links or road links physically changed or bypassed by the Scheme.
 - The area within 50m of other road links with potential to experience a short-term change of more than 1dB as a result of the Scheme.
 - Areas where there is a reasonable stakeholder expectation that an operational phase road traffic noise assessment would be undertaken.
- 6.4.40. The assessed traffic network spans from A38 Coombe Hill in the west, to A46 at Ashchurch in the north, to the A46 Bath Road in the east, and finally to the Cirencester Road at Brockworth in the South.
- 6.4.41. The noise model covers the area 600m from the Scheme, and bypassed routes such as Princess Elizabeth Way and Hayden Road. Where there is the potential for changes of 1dB in the short-term and/or long-term, additional roads have been included in the study area, such as the A417, Bishops Cleeve and Up Hatherley Way. The study area for the operational assessment is shown in Figure 6-3 of Appendix 6.1 (application document TR010063 – APP 6.15).
- 6.4.42. The predictions were undertaken at all 'Noise Sensitive Receptors' (NSR) within the study area, in order to identify the risks and constraints that noise imposes on the Scheme, as well as highlighting noise-sensitive areas that could be impacted by the potential Scheme. Both daytime noise levels ($L_{A10,18h}$) and night-time levels (L_{night}) were calculated using the noise model.
- 6.4.43. The Scheme has the potential to adversely affect noise sensitive receptors in the area. DMRB LA 111 notes that the definition of NSR is simply 'receptors which are potentially sensitive to noise'. A distinction is also made between 'residential properties' and 'other noise sensitive receptors', which may include:
- Hospitals.
 - Healthcare facilities.
 - Education facilities.
 - Community facilities.
 - Environmental Noise Directive (END) quiet areas or potential END quiet areas.
 - International and national or statutorily designated sites.
 - Public rights of way and cultural heritage assets.
- 6.4.44. The study area includes an informal Traveller site, just north of the M5 Junction 10 and next to the southbound carriageway. The number of residential properties at the site are not known, but the site has been included in the assessment.
- 6.4.45. The results of the noise modelling are used to determine potential noise impacts, the requirement of noise mitigation, and overall significance.
- 6.4.46. Road traffic noise calculations are undertaken using the following outputs from the traffic model:

- Traffic flows in vehicles Annual Average Weekday Traffic (AAWT) 18hour, the average number of vehicles over a year, on weekdays from 06:00 until midnight.
 - Traffic flows in vehicles Annual Average Day (07:00 to 19:00), Evening (19:00 to 23:00) and Night (23:00 to 07:00).
 - Percentage Heavy Duty Vehicles (HDV) content of total flow for the relevant time periods defined above.
 - Traffic speeds (kph) for the relevant time periods defined above.
- 6.4.47. DMRB LA 111 requires that the following traffic scenarios are assessed for the Scheme for a quantitative assessment:
- Do Minimum scenario (without Scheme) in the opening year (DMOY), in this case 2027.
 - Do Minimum scenario (without Scheme) in the future assessment year (DMFY) (typically 15 years after opening) in this case 2042.
 - Do Something scenario (with Scheme) in the opening year (DSOY) in this case 2027.
 - Do Something scenario (with Scheme) in the future assessment year (DSFY), in this case 2042.
- 6.4.48. The traffic information was exported from the SATURN model as a GIS map of the traffic links and a spreadsheet containing data per traffic link. The scenario used in the main operational noise assessment is Traffic Scenario S, which does not include traffic from strategic development sites.
- 6.4.49. However, for this Scheme an additional traffic model, Traffic Scenario R, was created which included the Scheme as well as the strategic development sites, which are three large housing developments close to the Scheme. This includes the safeguarded land to the north-west of Cheltenham, the North West Cheltenham Development Area (which includes Swindon Farm) and the West Cheltenham Development Area.
- 6.4.50. Traffic Scenario S does include some areas within all three developments that are not dependent upon transport infrastructure improvements. However, the strategic development sites identified in the JCS that require transport infrastructure to be fully realised, which will be delivered by the Scheme and the additional traffic associated with the strategic development sites is only present in Traffic Scenario R. Traffic Scenario R will be considered in the Cumulative Section of this chapter.
- 6.4.51. The following datasets are used produce a technically robust 3D noise model:
- LIDAR topography data.
 - OS Master map data including building outlines and carriageways.
 - OS AddressBase Plus data.
 - 3D alignment of the Scheme.
- 6.4.52. DMRB LA 111 states that operational phase vibration from road traffic is scoped out of the assessment methodology for appraising road schemes. No other sources of operational phase vibration were identified, and the issue of operational phase vibration has therefore not been considered any further.

Determination of significance

- 6.4.53. The predicted noise levels at the NSRs for each traffic scenario have been used to provide an indication of the number of properties that may potentially exceed the LOAEL and the SOAEL to establish impact significance in policy terms. The thresholds assigned to the LOAEL and the SOAEL set out in DMRB LA 111 are provided in Table 6-7. A facade noise level is the noise level 1m in front of the most exposed window or door in a building façade, whereas free-field assumes no reflective surfaces other than the presence of ground.

Table 6-7 - Operational noise levels of significance for all receptors (daytime and night-time)

Effect Level	Façade dB $L_{A10, 18h}$ (Daytime)	Free-field dB $L_{night, outside}$ (Night)
Adverse Effect (LOAEL)	≥ 55	40
Significant Adverse Effect (SOAEL)	≥ 68	55

Source: DMRB LA 111 Table 3.49.1

- 6.4.54. The LOAEL and SOAEL values are related to adverse, and significant adverse, effects on health and quality of life, respectively.
- 6.4.55. When compared with the guidance on road traffic noise from the WHO Environmental Noise Guidelines, 2018, the LOAEL values provided in Table 6-7 relate to 11% of the population being highly annoyed and 2% were highly sleep disturbed. For the SOAEL levels this increases to 23% annoyed and 6% highly sleep disturbed.
- 6.4.56. Whilst it is noted that LOAEL and SOAEL values are set for building receptors in the DMRB LA 111, the same criteria have also been used for open spaces in this assessment, in line with the DMRB LA 111.
- 6.4.57. The impact significance in EIA terms was determined by calculating the changes in noise associated with the Scheme. In accordance with the DMRB LA 111, short-term and long-term impacts were identified using the following comparisons:
- DMOY against DSOY (short-term).
 - DMOY against DSFY (long-term with the Scheme).
 - DMOY against DMFY (long-term without the Scheme).
- 6.4.58. The magnitudes of impact in the short and long-term defined in the DMRB are reproduced in Table 6-8 for both short and long-term impacts.

Table 6-8 - Classification of magnitude for noise impacts

Short-term impact classification	Change road traffic noise level dB $L_{A10,18h}/L_{night}$	Long-term impact classification
Negligible	0.0dB and < 1.0dB	Negligible
Minor	≥ 1.0dB and < 3.0dB	Negligible
Moderate	≥ 3.0dB and < 5.0dB	Minor
Major	≥ 5.0dB and < 10.0dB	Moderate
Major	≥ 10.0dB	Major

Source: DMRB LA 111 Table 3.54a and Table 3.51b

- 6.4.59. The DMRB LA 111 states that moderate and major adverse impacts are to be considered as potential significant adverse effects, in EIA terms, as part of an initial assessment. Final operational significance is determined with reference to contextual factors. This process requires the assessor to consider a number of holistic points related to the receptor and the wider environment before determining whether a significant adverse effect has arisen (see Table 6-9 below).

Table 6-9 - Determining final operational significance on noise sensitive buildings

Magnitude of Impact	Long-term noise change (dB $L_{A10,18h}$ or L_{night})
Noise level change (is the magnitude of change close to the minor/moderate boundary?)	1) Noise level changes within 1dB of the top of the 'minor' range can indicate that it is more appropriate to determine a likely significant effect. Noise level changes within 1dB of the bottom of a 'moderate' range can indicate that it is more appropriate to consider a change is not a likely significant effect.

Magnitude of Impact	Long-term noise change (dB $L_{A10,18h}$ or L_{night})
	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.
Differing magnitude of impact in the long-term to magnitude of impact in the short-term	1) Where the long-term impact is predicted to be greater than the short-term impact, it can be appropriate to conclude that a minor change in the short-term is a likely significant effect. Where the long-term impact is predicted to be less than the short-term it can be appropriate to conclude that a moderate or major change in the short-term is not significant.
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.
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) Conversely, if the sensitive parts of the receptor are exposed to the noise source, it can be more appropriate to conclude a minor change in the short-term and/or long-term is a likely significant effect. 3) It is only 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.
Acoustic context	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.
Likely perception of change by residents	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 NSRs. 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. 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.

Source: Table 3.60, DMRB LA 111

- 6.4.60. The application of the contextual factors means that a significant adverse effect can occur if the predicted road traffic noise levels with the Scheme exceed the SOAEL and are shown to increase by at least 1dB in the short-term.
- 6.4.61. In this assessment an adverse effect is deemed to occur at a noise sensitive receptor if the predicted noise levels equal or exceed the LOAEL and a perceptible change to the road traffic noise levels occur. The DMRB LA 111 advises that the threshold of perceptibility for change in operational road noise is 1dB $L_{A10,18h}$ in the short-term and 3dB $L_{A10,18h}$ in the long-term (typically 15 years from the planned opening of a Scheme).
- 6.4.62. Scenario S, the traffic model scenario without strategic development sites, was used to establish the overall significance of the Scheme, with Scenario R assessed within the Cumulative Section of this chapter.
- 6.4.63. Properties that could qualify for noise insulation under the Noise Insulation (Amendment) Regulations 1988 were identified from the predicted noise levels. NSRs that may potentially qualify for noise insulation are residential properties that experience road traffic noise levels greater than or equal to 68dB $L_{A10,18h}$ and are shown to experience an

increase of at least 1dB due to the Scheme and are situated within 300m of a new or altered road.

Limits of deviation

- 6.4.64. The assessment has been conducted within the Limits of Deviation (LoD) outlined within Chapter 2 - The Scheme (application document TR010063 – APP 6.2). The vertical and lateral LoD for the Scheme have been reviewed with respect to sensitive receptors identified within this ES chapter, and would not affect the conclusions of the assessment reported in this chapter.

6.5. Consultation

- 6.5.1. Full details of consultation undertaken is provided in Consultation report (TR010063 – APP 5.1 and TR010063 – APP 5.2).
- 6.5.2. A Non-Statutory Consultation took place in the Autumn of 2020 to help identify a preferred option for the new Junction 10. Based on that consultation, the preferred route announcement took place on the 16 June 2021.
- 6.5.3. A scoping request to PINS included an Environmental Scoping Report (published on the PINS website in July 2021) and a Scoping Opinion was received from PINS in August 2021. A response to the comments received in the Scoping Opinion is provided as Appendix 1.2 (application document TR010063 – APP 6.15).
- 6.5.4. Consultation on the methodology adopted for the PEIR Noise and Vibration chapter, that was issued as part of the statutory consultation (December 2021 to February 2022) was undertaken with CBC and TBC Environmental Health teams. Responses were provided by CBC and TBC:
- They were satisfied with the approach and methodology used in the assessed.
 - It was suggested that additional baseline surveys may be required if it is judged that the traffic circumstances have changed significantly since May/June of 2021 at the time of preparing the ES.
 - They requested a more detailed construction assessment for the ES, in line with comments within the PEIR.
 - They expect the ES to assess and determine the benefit and efficiency of the mitigation options.
 - They expect to see the ES identify the properties that are predicted to experience a residual significant adverse effect.
- 6.5.5. Consultation with National Highways was also undertaken, their comments included providing the methodology for the consideration of significant effects in the short-term.

6.6. Baseline conditions

- 6.6.1. Information regarding the existing ambient noise climate i.e. baseline conditions, and identification of potential noise impact constraints of the Scheme, are determined through reference to the following sources:
- Ordnance Survey base mapping to identify locations of residential and non-residential NSRs (residential properties, schools, hospitals and elderly care homes).
 - Strategic Noise Mapping and Noise Important Area datasets published by Defra in 2019.
- 6.6.2. Road traffic noise from the National Highways M5 motorway and Gloucestershire County Council (GCC) highways, such as the A4019, are the dominant sources of ambient noise in the study area. The land use within 600m of the Scheme is mainly agricultural, with clusters of properties located on the outskirts of Cheltenham. There are also areas of land near the Scheme which have been earmarked for building almost 9000 new properties, referred to as the strategic development sites identified in the JCS that require transport infrastructure improvements to be fully realised, which will be delivered by the Scheme.

- 6.6.3. There is a railway line within 1 km of the Scheme, which crosses the A4019 approximately 500m from the junction with Princess Elizabeth Way, as well as Stoke Road and the M5 south of Junction 11. It is also noted that the A-roads in the area, such as the A4019, are widely used by HDVs and there is some local concern about vibration impacts from HDV traffic.
- 6.6.4. Non-residential receptors include schools and hospitals such as Hesters Way Primary School and Cheltenham Hospital, religious buildings such as Masjidul Falah Mosque and St Mary Magdalene Church and Community facilities such as Stoke Orchard Community Centre and Springbank Community Resource Centre.
- 6.6.5. The study area does not include any protected green areas, such as SSSI, but does include four green community spaces within Cheltenham Town Centre; Hesters Way Park, Springfields Park, St Peters Park Chelt Walk and St Mark’s Recreation Ground, plus the footpaths and public rights of way around the A4019 and M5.
- 6.6.6. A number of residential and farm buildings will be demolished as part of the Scheme, to make space for the new M5 Junction 10 layout. These buildings have not been included in the operation phase of the Scheme.
- 6.6.7. Noise surveys were undertaken in May/June 2021, following the lifting of all but the final phase of lockdown restrictions. It is considered that the traffic levels were at/close to pre-lockdown conditions, and it did not significantly affect the baseline noise levels in the study area. The weather conditions during the survey were generally dry with low wind speeds.
- 6.6.8. The survey was a combination of short-term attended measurements at four locations and unattended long-term attended measurements at one location. The short-term measurements were undertaken at Withybridge Lane Layby, Blenheim on the A4019-Cheltenham, the layby on the A4019-Uckington and Orchard House Coombe Hill. The long-term measurement location was on Withybridge Lane, where noise monitoring was undertaken over seven days.
- 6.6.9. At all noise survey locations, the dominant source of noise was road traffic on the M5, A38, A4019 and Withybridge Lane. Sound from aeroplane flyovers was also observed at Withybridge Lane. The summary of the noise survey results is shown Table 6-10 with the locations of the survey shown in Figure 6-3 of Appendix 6.1 (application document TR010063 – APP 6.15). Sites labelled ‘Sx’ were measurements taken in accordance with the CRTN ‘Shortened Procedure’ over one day. The site called ‘L1’ was the location of a logging sound level meter.

Table 6-10 - Summary of noise survey

Identifier	Location	Date(s) of measurement	L _{A10,18hour} dB	Daytime L _{Aeq, 16hr} dB	Night-time L _{Aeq, 8hr}	Dominant noise sources during the survey
S1	Withybridge Lane Layby, near ‘House in the Tree’ pub	27/05/2021	65.1	65.2	N/A	Road traffic on Withybridge Lane, aeroplane flyovers
S2	Blenheim, A4019, Cheltenham, GL51 9SL	27/05/2021	80.4	77.8	N/A	Road traffic on A4019
S3	The A4019 Layby	27/05/2021	74.5	72.3	N/A	Road traffic on A4019
S4	Orchard House, A4019, Coombe Hill,	27/05/2021	70.4	70.0	N/A	Road traffic on A38 and A4019

Identifier	Location	Date(s) of measurement	L _{A10,18hr} dB	Daytime L _{Aeq, 16hr} dB	Night-time L _{Aeq, 8hr}	Dominant noise sources during the survey
	Gloucester GL19 4BA					
L1	1 Withybridge Lane, Cheltenham GL51 0TH	11/06/2021 - 18/06/2021	57.4	56.9 (weekend 55.2)	53.5 (weekend 53.2)	Road traffic on M5 and Withybridge Lane, aeroplanes

- 6.6.10. It is expected that most receptors which are within 25m of the motorway have baseline noise levels up to 75dB L_{A10,18h}. The measurements taken on the A4019 show that noise in the front gardens of some of these properties already exceed 80dB L_{A10,18h}, which is above the SOAEL. According to Defra strategic noise mapping, the majority of properties within the study area have daytime baseline noise levels well below these values.
- 6.6.11. The detailed results from the noise survey, plus calibration certificates, are found in Table 6-36 to Table 6-37 of Appendix 6.1 (application document TR010063 – APP 6.15).
- 6.6.12. Noise Important Areas (NIA) are identified to highlight any particular constraints on the Scheme. These are the areas where 1% of the population are affected by the highest noise levels from major roads are located according to the strategic noise mapping undertaken by Defra under the terms of the Environmental Noise (England) Regulations 2006, as amended.
- 6.6.13. The following NIA were identified near the Scheme.
- NIA 3951 (National Highways) covers the existing junction at the M5 and contains 19 receptors, however, the majority of these properties would be demolished with the Scheme, leaving old Sheldon Cottages.
 - NIA 3952 (National Highways) is on the M5 approximately 800m north of the existing junction and contains 1 receptor.
 - NIA 11921 (Gloucestershire) located on the A4019, to the west of M5 Junction 10. It represents one property between the M5 and Coombe Hill Junction.
 - NIA 3950 (Gloucestershire) represents 2 properties on the A4019 east of M5 Junction 10.
 - NIA 3948 (Gloucestershire) represents 22 properties on the A4019 east of the Junction, near Moat Lane.
 - NIA 3949 (Gloucestershire) represents 2 properties on the A4019 east of the Junction, near Sandpiper Drive.
 - NIA 11920 (Gloucestershire) represents at least 6 houses and a block of flats on the A4019 east of the B4634 crossroads, near Yeend Close.
 - NIA 3893 (Gloucestershire) represents 6 properties at Glyndbridge Gardens, located adjacent to the A4019.
- 6.6.14. There are additional NIAs close to the study area that may also be affected by the Scheme, including those on the M5 north of Junction 11 (NIAs 3900, 3901 and 3902), the A4019, Princess Elizabeth Way (NIAs 3945, 3946 and 3894), the A40 (NIAs 6036, 3898 and 3899) and a number of other roads within Cheltenham.

Assessment of baseline conditions

- 6.6.15. For the construction assessment, key receptor locations have been identified as being representative of the communities surrounding the planned construction areas. Baseline noise levels have been identified at each of these key receptor locations using the Defra strategic noise mapping data.

- 6.6.16. Mapping showing the key receptor locations for the construction noise assessment can be found in Figure 6-4 of Appendix 6.1 (application document TR010063 – APP 6.15). The addresses of the key receptor locations are provided in Table 6-11 below, along with the baseline noise levels identified for these properties.
- 6.6.17. The Defra strategic noise maps are provided as L_{den} , $L_{Aeq, 16hr}$ (07:00 to 23:00) and L_{night} (23:00 to 07:00). Given that there isn't specific day (07:00 to 19:00) or evening (19:00 to 23:00) data, the $L_{Aeq, 16hr}$ strategic noise maps have been used to approximate both the day and evening noise levels. The strategic noise map for L_{night} was used to determine the night-time noise levels. The strategic noise maps are found in Figure 6-1 and Figure 6-2 of Appendix 6.1 (application document TR010063 – APP 6.15).
- 6.6.18. Where appropriate, baseline noise levels have been derived from Defra strategic noise mapping, where the lower value of the Defra noise contour banding has been considered to be the representative baseline. This ensures that a 'worst case' assessment takes place as the reference baseline value is as low as possible for identifying a conservative threshold value (using BS 5228 ABC method) which is subsequently used in the assessment of construction noise.

Table 6-11 - Key receptor locations identified for the construction assessment with baseline noise levels per period

ID	Address	Estimated Daytime/ Evening Noise Level (dB $L_{Aeq, T}$)	Estimated Night-time Noise Level (dB $L_{Aeq, T}$)
1	Sheldon Cottages	60	55
2	Barn Farm	70	65
3	Informal Traveller site	70	70
4	Butlers Court	60	60
5	Stanboro' Cottage, Stanboro Lane	65	65
6	Stanboro, Stanboro Lane	60	60
7	Butlers Court Cottages/ Mill House Farm	55	55
8	Holmdale, B4634	60	55
9	Aldreth, B4634	60	55
10	The House In The Tree, B4634	60	55
11	Elm Cottage, B4634	60	55
12	Barn Close, B4634	60	55
13	The Brow, B4634	60	50
14	Rose Cottage, Cooks Lane	70	65
15	Mayville, Cooks Lane	60	55
16	Cooks Farm, Cooks Lane	60	50
17	The Nook, Cooks Lane	55	50
18	Hollybank, A4019	75	65
19	The Green	70	60
20	Cremyll, A4019	65	55
21	Landrean, A4019	65	55
22	Linton, The Green	60	55

ID	Address	Estimated Daytime/ Evening Noise Level (dB L _{Aeq, T})	Estimated Night-time Noise Level (dB L _{Aeq, T})
23	Pigeon Farm Barns, The Green	60	50
24	The Old Dairy, The Green	55	50
25	Uckington Farm, The Green	55	50
26	Maple Lodge, A4019	70	60
27	Sandpiper Drive	70	60
28	Hilary, A4019	70	60
29	26 Homecroft Drive	60	50
30	23 Homecroft Drive	55	50
31	21 Homecroft Drive	55	50
32	17 Homecroft Drive	55	50
33	14 Homecroft Drive	55	50
34	90 River Leys	70	60
35	138 River Leys	65	55
36	113 River Leys	60	50
37	126 River Leys	55	50
38	45 River Leys	55	50
39	18 River Leys	55	50

6.7. Potential impacts

6.7.1. The Scheme has the potential to affect existing conditions during construction and when operational in a number of ways, as discussed below.

Construction

6.7.2. Construction of the Scheme has the potential to affect nearby receptors, either due to noise and vibration from demolition and construction activities themselves, or from additional HDVs associated with construction activities on the local road network.

6.7.3. In addition, the local road network may experience changes in traffic flows and speeds during construction, as a result of temporary traffic management measures or diversions. It should be noted, however, that any effects on the noise climate from construction activities, including construction traffic and traffic diversions, would be temporary i.e. during the period of construction works only.

6.7.4. The properties that are closest to the works, and therefore the most likely to be affected by construction noise, are alongside the A4019. Properties may also be affected that are close to the M5 or the Link Road.

Operation

6.7.5. Once the Scheme is operational, the noise climate could be affected (positively or negatively) by changes in traffic flows, speeds and composition. Additionally, noise levels at nearby receptors could also be affected by any changes to the distance between carriageways and the NSR, as a result of a change to road alignment and road surfacing.

6.7.6. In particular, the changes to the layout of the A4019, the M5 Junction 10 itself and the Link Road are the locations where the biggest changes in noise are expected, as a result of the changes to the layout as well as the traffic flows. Properties which are closer to the

road are likely to experience an increase in noise, with those further away likely to experience a decrease.

- 6.7.7. In addition, there are likely to be changes in noise due to the traffic changes alone. On roads such as Princess Elizabeth Way in Cheltenham, the traffic that would have travelled through the town can now enter onto, and exit from, the south of the M5 at Junction 10, reducing noise along the route. In contrast, the traffic from other areas will be drawn to the M5 Junction 10 and will increase the traffic on local roads such as Stoke Road.
- 6.7.8. It is expected that the strategic development sites (Traffic Scenario R) will exacerbate the number of potential adverse effects and reduce the number of beneficial effects on the roads affected by Scenario S. In addition, it is expected that this will also affect additional roads, especially on access routes to the development. The results of the Scenario R assessment will be presented in the Cumulative Section of this chapter.

6.8. Mitigation measures

Objectives

- 6.8.1. Design, mitigation, and enhancement measures are incorporated into the Scheme using the following order of priority, aligned with the aims of the NPSE:
1. Avoidance and prevention - measures to prevent the effect
 2. Reduction - where avoidance is not possible, then measures are used to lessen the magnitude or significance of effects
 3. Remediation - where it is not possible to avoid or reduce a significant adverse effect, measures are used to offset the effect
- 6.8.2. The following types of mitigation measures are defined in the DMRB LA 104²:
- Embedded mitigation: project design principles adopted to avoid or prevent adverse environmental effects and
 - Essential mitigation: measures required to reduce and if possible offset likely significant adverse effects
- 6.8.3. The embedded and essential mitigation relevant to noise and vibration is summarised in Table 6-12.

Table 6-12 - Embedded and essential mitigation measures

Phase	Mitigation measure	Classification
Construction	Environmental Management Plan with noise and vibration reduction measures for the construction phase, such as Best Practicable Means	Embedded
Construction	Traffic Management Plan for the construction phase	Embedded
Construction	Development and implementation of a Community Engagement Plan aiming to provide information about the Scheme to a wide audience	Embedded
Construction	Proactive stakeholder engagement during the construction phase focussed on specific locations that would be affected the most by construction works	Essential
Construction	Use of low vibration piling methods where reasonably practicable	Essential
Construction	Use of temporary environmental noise barriers and using lower working platform heights for works in cuttings to maximise the benefit of these noise barriers	Essential

² Highways England, Transport Scotland, Welsh Government and Department for Infrastructure (2020). Design Manual for Roads and Bridges LA 104 Environmental assessment and monitoring. Revision 1

Phase	Mitigation measure	Classification
Construction	Using low noise construction plant and undertaking one high noise-generating activity at a time close to noise sensitive areas	Essential
Construction	Temporary rehousing and/or noise insulation for qualifying residential properties	Essential
Operation	Design of the Scheme to minimise road traffic noise level, including alignment of the M5 Junction 10, the A4019 and the Link Road	Embedded
Operation	Low noise road surfacing on all of the new and altered sections of the M5	Embedded
Operation	Routine Road Maintenance	Embedded
Operation	Permanent environmental noise barriers located at M5 Barn Farm and the informal Traveller site, and A4019 at Cooks Lane, The Green and the A4019 between Homecroft Drive and the B4634	Embedded
Operation	Determine quiet green spaces close to affected NSR that could be used for relaxation and leisure, particularly by people that are exposed to levels of noise which may lead to annoyance, sleep disturbance or health effects.	Embedded

6.8.4. Further information relating to the embedded mitigation measures is provided in Chapter 2 - The Scheme (application document TR010063 – APP 6.2) of this Environmental Statement. The essential mitigation measures are detailed further in the following subsection.

Embedded mitigation - Construction

6.8.5. The appointed Contractor would implement an Environmental Management Plan (EMP), which would be approved by GCC in its role as county planning authority prior to the commencement of construction works. The EMP would outline the following:

- Environmental management and responsibilities.
- Monitoring and auditing processes.
- Procedures that will be used to complete different construction activities.
- Complaint response procedures.
- Community and stakeholder liaison processes.

6.8.6. A first iteration EMP (application document TR010063 – APP 7.3) and Register of Environmental Actions and Commitments (REAC) (application document TR010063 – APP 7.4) have been produced and submitted as standalone documents as part of the DCO submission.

6.8.7. A Section 61 Prior Consent application under the Control of Pollution Act 1974 may also be required and submitted for some of the construction works, especially if night-time working is proposed.

6.8.8. The EMP (second iteration), to be produced at Detailed Design stage, shall include a Noise and Vibration Management Plan to control noise and vibration emissions from the construction works. The Noise and Vibration Management Plan shall incorporate good working practices, as well Best Practicable Means, including but not limited to the following measures where possible.

- Use of vehicles, plant, and equipment that generate lower levels of noise or vibration should be selected over alternatives that produce higher levels of noise or vibration.
- All vehicles and plant should be fitted with effective exhaust silencers which should be maintained in good and efficient working order.
- All compressors and generators should be ‘sound reduced’ models fitted with

properly lined and sealed acoustic covers which should be kept closed whenever the machines are in use.

- All ancillary pneumatic percussive tools should be fitted with mufflers or suppressors as recommended by the manufacturers which should be kept in a good state of repair.
- Machines in intermittent use should be shut down when not in use or where this is impracticable, throttled down to a minimum.
- The site compound and static machines should be sited as far as is practicable from noise sensitive buildings.
- Where practicable, plant with directional noise characteristics should be orientated to minimise noise at nearby properties.
- Plant should be certified to meet the current EU legislation and should not be louder than the noise levels provided in Annex C and D of BS 5228 Part 1.
- Temporary noise barriers or other noise containment measures installed to minimise construction noise levels.
- The loading or unloading of vehicles and the movement of equipment or materials should be undertaken in a manner that minimises noise generation.
- Concrete mixers should not be cleaned by hammering the drums.
- When handling materials, care should be shown not to drop materials from excessive heights.

6.8.9. The Noise and Vibration Management Plan would also require the appointed Contractor to consult with the Environmental Health Departments, at TBC and CBC, prior to the commencement of construction works. From this, guidance would be obtained on their requirements for managing and controlling noise and vibration from construction works, including communication preferences for updates during the construction phase.

6.8.10. The Contractor would have the option to apply for a Section 61 Prior Consent under the Control of Pollution Act 1974 for some or all of construction works, including daytime working and any of the limited activities taking place at night. This should be discussed when engaging with the Local Authorities prior to works commencing.

6.8.11. It is a requirement of GCC that the Contractor is a member of the Considerate Contractors Scheme, that is recognised by industry and the Government for encouraging firms to be sensitive to the environment.

6.8.12. Good stakeholder relations are often the most effective way to manage potential construction noise and vibration impacts on site. Implementation of a Community Engagement Plan would ensure that local residents and other affected parties are kept informed of the progress of the works, including when and where the noisiest activities would be taking place and how long they are expected to last. Communication mechanisms include newsletters, newspaper and radio announcements, and communications from the Contractor. The Applicant's website would include a webpage for the Scheme that is regularly updated to reflect the status of construction works, construction working hours, information about traffic diversions or road closures, mitigation measures that are implemented to reduce noise and vibration levels.

6.8.13. The Contractor would provide all local residents with a point of contact to discuss any queries relating to the construction works or to raise complaints. All noise complaints shall be effectively recorded, investigated, and addressed. Additionally, members of the public would be able to use the National Highways Customer Contact Centre or the GCC website to raise queries or complaints, which would be investigated and responded to as appropriate.

6.8.14. Even with appropriate mitigation in place, it may not be possible to eliminate all noise and vibration impacts. However, best practice, considerate working hours as well as frequent and open communications with stakeholders would help to reduce the residual impact of construction noise and vibration.

Embedded mitigation - Operation

- 6.8.15. The design of the M5 Junction 10 itself provides an embedded mitigation measure for operational road traffic noise. The slip roads on either side of the M5 maximise screening of noise from the road, such as for Sheldon Cottages.
- 6.8.16. The alignment of the A4019 to the east of the M5 Junction 10 repositions the road further away from noise sensitive receptors located within three Noise Important Areas, which reduces road traffic noise contributions from this road within the Noise Important Area (NIA 3948, 3949 and 3950).
- 6.8.17. The Scheme includes low noise road surfacing on all of the new and altered sections of the M5, which reduces noise generated from the interaction between tyres of moving vehicles and the road, where the speed of the traffic on the road exceeds 75kph. In the absence of acoustic performance data for a specific road surfacing product, a correction of -3.5dB is assumed in line with DMRB LA 111. It is noted that there are road surfacing products on the market which could reduce tyre-road noise further.
- 6.8.18. It is not GCC policy to surface roads with a low noise surfacing and the GCC roads, such as the A4019 and the Link Road, would not be surfaced with a low noise surfacing. The surface correction used for hot rolled asphalt on higher speed roads, such as the A4019, was -0.5dB. All roads with speeds below or equal to 75kph used a surface correction of -1.0dB.
- 6.8.19. The operational phase of the Scheme includes routine maintenance of the road surfacing to ensure that over time the use of the road doesn't lead to additional or elevated levels of noise or vibration. Remedial works would be undertaken where defects to the road surfacing are identified.
- 6.8.20. Permanent environmental noise barriers were included in the Scheme's design to reduce road traffic noise levels at five locations. Proposals for the environmental noise barriers were developed in consultation with other discipline specialists to avoid the noise barriers themselves creating significant effects, for example, in terms of landscape and visual impact, biodiversity and cultural heritage assets. During these discussions, the practicality of the environmental noise barriers was appraised. Where competing requirements were identified, the design of the environmental noise barriers were adjusted so that all requirements could be met.
- 6.8.21. The specification and material of the noise barriers will be determined during the Detailed Design of the Scheme, although all barriers must be compliant with the requirements in DMRB LD 119. Further discussion on the visual impact and location of barriers is provided in Chapter 9 - Landscape and Visual (application document TR010063 – APP 6.7). Information regarding these noise mitigation measures have been included in Table 6-13 and shown in the Environmental Masterplan (application document TR010063 – APP 2.13).
- 6.8.22. For barriers numbered M1 to M5, the table indicates the area and NIA. The informal Traveller site is not within a NIA, but properties at this location experience noise levels that are above the SOAEL.

Table 6-13 - Embedded scheme mitigation

Mitigation no.	Location	Description
M1	A4019 - Church View (NIA 3950)	160m long, 2m tall reflective noise barrier located adjacent to properties within Church View and alongside the A4019 westbound carriageway.
M2a	A4019 - The Green (NIA 3949)	95m long, 2m tall absorptive noise barrier located adjacent to properties west of The Green and alongside the A4019 eastbound carriageway.
M2b	A4019 - The Green (NIA 3949)	Up to 150m long, 2m tall absorptive noise barrier located adjacent to properties West of the Green and alongside the A4019 eastbound Carriageway.

Mitigation no.	Location	Description
M3	A4019 (NIA 3948)	350m long, 2m tall absorptive noise barrier located adjacent to properties alongside the A4019 and alongside the A4019 westbound carriageway. Barrier includes two short gaps for crossings.
M4	Barn Farm (NIA 3952)	130m long, 2m tall reflective noise barrier alongside the M5 northbound.
M5	Informal Traveller site	150m long, 2m tall reflective noise barrier alongside the M5 southbound.

6.8.23. The decision to include noise barriers M1-M5 in the Scheme was taken on the basis of noise reduction analyses, presence of the NIA designation, and space to implement these mitigation measures.

6.8.24. Inclusion of the noise barriers detailed in Table 6-13 in the Scheme's design results in perceptible noise reductions from the unmitigated scenario. The benefits of including the barriers are presented in Table 6-14.

Table 6-14 - Predicted benefit of operational noise barriers

Mitigation no.	Number of Properties	Above daytime SOAEL/ Noise Insulation Regulations in DMOY	Above daytime SOAEL/ Noise Insulation Regulations in DSFY	Below daytime SOAEL/ Noise Insulation Regulations with barrier DSFY	Minor Benefit (1-3dB)	Moderate or Major Benefit (3dB plus)
M1	Church View (5)	Yes (2)	Yes (2)	Yes (5)	Yes (2)	Yes (1)
M2a	Hollybank (2)	Yes (2)	Yes (2)	Yes (2)	Yes (2)	No
M2b	The Green (6)	Yes (5)	No	Yes (6)	Yes (4)	Yes (2)
M3	A4019 (23)	Yes (23)	Yes (1)	Yes (23)	No	Yes (23)
M4	Barn Farm (1)	Yes (1)	Yes (1)	Yes (1) Ground Floor	Yes (1)	No
M5	Informal Traveller site (at least 1)	Yes (1)	Yes (1)	No	No	Yes (1)

6.8.25. The EMP and REAC, which have been produced and submitted as part of the DCO application, will ensure the implementation of these operational noise controls.

6.8.26. It is not possible to reduce noise levels at all receptors to below LOAEL or SOAEL where receptors face directly onto roads. Noise barriers are impractical on roads where there are access requirements, as the gaps in the barrier reduce the performance.

6.8.27. Barriers M1 to M4 (see Table 6-13) are used to successfully mitigate noise levels within Noise Important Areas (NIA 3948, 3949, 3950, 3952), as well as within the informal Traveller site. This responds to Aim 3 as set out in the 'England National Application Annex to DMRB LA 111' to improve the noise environment.

Essential mitigation – Construction

6.8.28. In addition to the embedded mitigation measures stated in Chapter 2 - The Scheme (application document TR010063 – APP 6.2), a number of essential mitigation measures would be implemented in the construction phase. As part of the stakeholder engagement measures, the local residents likely to be affected the most by the construction phase of the Scheme would be identified and proactively engaged with. This would enable any emerging issues at these locations to be identified and for appropriate action to be taken.

- 6.8.29. Temporary noise barriers would be installed at key locations during the construction phase to reduce construction noise as far as possible. These locations include the boundary of the construction compound and work sites close to sensitive receptors.
- 6.8.30. Given that properties are close to the works along the A4019, temporary noise barriers will be installed at the site of the operational noise barriers; until they have been permanently installed. Additional temporary noise barriers will also be required for works to the east of the M5 Junction 10, west of the B4634 and Withybridge Lane/the B4634 to reduce the potential for significant adverse construction noise levels.
- 6.8.31. Temporary noise barriers can reduce construction noise by 5-10dB L_{Aeq} depending on the relative positions of the construction activities, the temporary noise barrier, and the sensitive receptor. According to BS 5228 Part 1, a 5dB reduction can be achieved if the temporary noise barrier screens the construction activity or equipment so that it is just visible from the viewpoint of the NSR. Greater reductions of 10dB can be achieved if the plant or activity is fully screened from the NSR.
- 6.8.32. To minimise construction noise levels further, the Contractor will undertake the following additional measures:
- Construction plant with electric engines are new to the UK market – these will be used in addition to plant using quieter EURO 6 diesel engines. Both of these would be targeted to areas where economically viable or where they would result in other indirect benefits such as reducing the likelihood of adverse noise effects.
 - Where possible, reduce the level of the working platform used to construct any of the structures, so that cutting slopes provide additional screening of noise.
 - Where possible, undertake only one high noise-generating operation in sensitive areas at one time.
 - The mandatory use of plant with white-noise reversing alarms.
- 6.8.33. Where construction noise levels exceed certain threshold noise levels for a time period exceeding 10 days or more in a consecutive 15-day period or any 40 days in a consecutive 6-month period, the Applicant may be required to implement a noise insulation or temporary rehousing as last resort. Guidance on noise insulation and rehousing is provided in BS 5228 Part 1 Annex E.4, which provides examples of noise levels that could trigger the Applicant to implement these measures.
- Noise insulation may be triggered at the higher of a noise level of at least 5dB above the pre-construction ambient noise levels or the levels presented in Table 6-15.
 - Temporary re-housing may be triggered at the higher of a noise level of at least 10dB above the pre-construction ambient noise levels or the levels presented in Table 6-15

Table 6-15 - Examples of trigger levels for noise insulation and temporary rehousing

Time	Time Period	Averaging Time	Noise Insulation trigger level ($L_{Aeq, T}$ dB) ³	Temporary rehousing trigger level ($L_{Aeq, T}$ dB)
Monday to Friday	07:00 – 08:00	1 hour	70	80
	08:00 – 18:00	10 hours	75	85
	18:00 – 19:00	1 hour	70	80
	19:00 – 22:00	3 hours	65	75
	22:00 – 07:00	1 hour	55	65
Saturday	07:00 – 08:00	1 hour	70	80
	08:00 – 13:00	5 hours	75	85
	13:00 – 14:00	1 hour	70	80
	14:00 – 22:00	3 hours	65	75
	22:00 – 07:00	1 hour	55	65

Source: British Standards Institution (2014) BS 5228 Part 1, Table E2.

³ All noise levels are predicted at 1m in front of the most exposed of any windows and doors in any façade of any eligible residential property

- 6.8.34. Once all mitigation is in place, the daytime noise thresholds for noise insulation or temporary rehousing only have the potential to be exceeded in areas where existing noise levels are low, but works are required less than 25m from a property, such as local access roads off the A4019 to Stanboro' Villa and Sheldon Cottages and on Old Gloucester Road (B4634) near the West Cheltenham Link Road. However, given that the extent of works in these areas is fairly minimal it is unlikely that the relevant threshold will be exceeded for a sufficient duration to trigger this action.
- 6.8.35. In addition, properties may exceed the evening and/or weekend threshold for noise insulation that are within 25m of the works along the A4019. However, if evening and night-time works are avoided where possible, it is unlikely that the threshold for noise insulation will be exceeded for a sufficient duration to trigger this action.
- 6.8.36. The need to implement noise insulation or temporary rehousing measures will be finalised during the Detailed Design stage when a detailed construction programme is available. This would enable the Principal Designer to confirm whether the thresholds in Table 6-15 would be exceeded for a period of time sufficient to trigger these actions during any of the construction phases. This would also enable identification of the appropriate timescales for the duration of any temporary rehousing.
- 6.8.37. To mitigate vibration impacts during construction, equipment and processes that result in low vibration levels would be identified during the Detailed Design stage. In particular, the piling methods would be selected carefully to minimise noise and vibration impacts at receptors.
- 6.8.38. It is understood that rotary bored piling will be used for all structures as the preferred method of piling for the Scheme. However, the piling methods that would be used for the Scheme will be confirmed during the Detailed Design stage.
- 6.8.39. Methods that generate high levels of vibration such as percussive piling shall be avoided as far as practicable.
- 6.8.40. The implications of the use of specific mitigation measures on cost and construction timescales would be considered by the Contractor during the Detailed Design of the Scheme.
- 6.8.41. Good management of construction traffic and diversion routes in the local area, through the use of the Traffic Management Plan, onto the signed diversion route roads would lead to fewer roads being affected by increases in traffic during the closures of the slip roads. The discouragement of HDVs on local roads such as the roads through Elmstone Hardwicke, Boddington and Pamington Lane, may reduce and improve the character of the traffic noise, but deterring all diversion traffic from these roads onto the official diversion routes would be the most effective.

Essential mitigation – Operation

- 6.8.42. The new slip roads at the M5 Junction 10 will result in an increase in traffic movements between Bishops Cleeve and the M5 Junction 10 along Stoke Road, through the village of Stoke Orchard.
- 6.8.43. Measures to mitigate predicted changes in noise levels on Stoke Road will be investigated by GCC as a separate project outside the scope of the Scheme, to be completed in advance of the Scheme opening.
- 6.8.44. Even with the embedded and essential mitigation measures for the operational phase of the Scheme described above, significant adverse effects may still occur at some NSR. Residential properties at some locations may be eligible for noise insulation under the Noise Insulation (Amended) Regulations 1988 provided that the requirements for eligibility set out in the Regulations are met. In this case, the Applicant would offer to provide noise insulation for qualifying windows and doors in eligible residential properties or make a payment for these works to be undertaken. Similarly, properties may qualify under the Highways Noise Payments and Movable Homes (England) Regulations 2000.
- 6.8.45. The section on interventions within the WHO Environmental Noise Guidelines, 2018, indicates that in addition to source interventions (such as low noise surfacing), path interventions (such as barriers) and changes in infrastructure (such as a new road tunnel),

other physical interventions could be used; such as the availability of quiet facades and/or the existence of a nearby green space.

- 6.8.46. These green spaces are used as external community areas, close to residential areas, that residents can use for leisure and relaxation, such as town parks and countryside walks. This is particularly important in areas when people are exposed to levels of noise in their homes and gardens which may lead to annoyance, sleep disturbance or health effects. Although there are no protected green spaces within the study area of the Scheme, such as SSSI, there are a number of parks and footpaths.
- 6.8.47. Within Cheltenham Town Centre there are four green community spaces, within Hesters Way Park, Springfields Park, St Peters Park Chelt Walk and St Mark’s Recreation Ground, and noise levels are typically less than 50dB L_{A10,18hr}. In addition, the walking routes which are around the A4019 and M5 generally experience noise levels that are below 55dB L_{A10,18hr} once 200 to 300m from the A4019 and 600m from the M5. It is essential that green spaces are available to people that live, work and study in this area.
- 6.8.48. Community green areas will be assessed as part of construction and operational assessment of the Scheme.
- 6.8.49. No additional noise barriers have been included for the North West Cheltenham Development Area for Traffic Scenario R, as mitigation measures and the effect of noise on development’s masterplan design should be considered by the housing developer.

6.9. Residual effects

- 6.9.1. As discussed in the previous subsection, the Scheme incorporates several embedded and essential mitigation measures during its construction and operational phases. The effects of these mitigation measures are inherent in the assessment outcomes presented in this subsection unless otherwise stated. It is therefore considered that the reported assessment outcomes represent the residual effects of the Scheme.

Construction

- 6.9.2. This part of the assessment identifies the noise levels predicted to be experienced at key receptor locations throughout the construction period.
- 6.9.3. Construction noise impacts would vary throughout the construction period. Noise levels experienced at sensitive receptor locations are dependent on the tasks being undertaken and the methodology employed by the Contractor.
- 6.9.4. During the Detailed Design stage, the level of noise impacts for NSR would be further examined based on a more detailed construction programme.
- 6.9.5. For this assessment, multiple planned construction activities have been identified following guidance from the project team using the best information available and by using professional judgement.
- 6.9.6. Noise levels from these activities were compared with the BS 5228 noise threshold values derived from baseline noise levels for each key receptor location to establish the magnitude of impact and significance of effect per construction activity (in accordance with DMRB LA 111, Tables 3.12 and 3.16). Note that, the determination of significance has not been influenced by any noise insulation or temporary rehousing considerations. The planned construction activities considered in this assessment are contained in Table 6-16 below. The list of plant used in this assessment has been provided in Table 6-38 of Appendix 6.1 (application document TR010063 – APP 6.15).

Table 6-16 - Construction activities assessed

Location	Activity	Description	Duration in weeks
M5 J10	Earthworks	Topsoil Strip – Strip	4
		Topsoil Strip – Stockpile	4
		Imported Fill – Place, Spread Compact	41
		Excavated Fill – Place, Spread Compact	7
		Re-soil Batters – Load out from Stockpile	2

Location	Activity	Description	Duration in weeks
		Resoil Batters – Spread	2
		Topsoil in Verge Fill – Load Out	2
		Topsoil in Verge Fill – Placing	2
M5 J10	Drainage	Excavate Balance Ponds	2
		Carrier Drainage	4
		French Drains	4
M5 J10	Culvert Extensions	Excavation of Bypass Channels	4
		Breakout of Existing Headwalls	4
		Construction of Culverts	8
		Overpumping	4
M5 J10	Pavement	Place Sub-Base	6
		Pavement – Slips	4
		Pavement – Gyratory	2
M5 J10	Planing of Junctions	Tie-Ins to M5	2
Piffs Elm Structures	Base	Piling – Platform	1
		Piling – Install Piles	2
		Excavate Bases	1
		Formwork -Bases	2
		Concrete Bases	0.5
		Place Rebar Bases	2
Piffs Elm Structures	Columns	Formwork	4
		Concrete	0.8
		Rebar	2
		Place Precast Sleeves	2
Piffs Elm Structures	Reinforced Earth Abutments	Erect Precast panels, Place Fill	6
Piffs Elm Structures	Lower Diaphragm	Formwork	2
		Concrete	1
		Rebar	2
Piffs Elm Structures	Deck	Prepare Hardstanding – Fill	1
		Set Up Trestles	2
		Unload beams	1
		Splice beams	1
		Fix Permanent Formwork & Rebar	2
		Fix Precast String Course	2
		Concrete Deck	1
		Position Deck	1
Piffs Elm Structures	Upper Diaphragm & deck Stitches	Formwork	2
		Concrete	1
		Rebar	2
Link Road	Earthworks	Topsoil Strip – Strip	4
		Topsoil Strip – Stockpile	4
		Excavated Fill – Place, Spread Compact	13
		Resoil Batters – Load out from Stockpile	4
		Resoil Batters – Spread	4
		Topsoil in Verge Fill – Load Out	3
		Topsoil in Verge Fill – Placing	3

Location	Activity	Description	Duration in weeks
Link Road	Drainage	Excavate Balance Ponds	2
		Carrier Drainage	7
		French Drains	7
Link Road	Pavement Roadway	Place Sub-Base	5
		Pavement – the Link Road	4
		Pavement – Junctions	2
Link Road	Pavement Footpath	Place Sub-Base	4
		Pavement – the Link Road	5
Link Road	Planing of Junctions	B4634 Tie Ins	0.5
Link Road	Transport to Site	Road Wagons	12
River Chelt Structures	Base	Piling – Platform	1
		Piling – Install Piles	2
		Excavate Bases	1
		Formwork -Bases	2
		Concrete Bases	2
		Place Rebar Bases	2
River Chelt Structures	Abutment Walls	Formwork	4
		Concrete	4
		Rebar	2
River Chelt Structures	Deck	Unload and place beams	1
		Fix Permanent Formwork & Rebar	3
		Fix Precast String Course	3
		Concrete Deck	1
Flood Culverts	Construction	Excavate for Base	1
		Spread and compact Backfill	1
		Place Culvert Units	5
		Headwalls, Rebar & Formwork	4
A4019	Earthworks	Topsoil Strip – Strip	6
		Topsoil Strip – Stockpile	6
		Imported Fill – Transport to site	22
		Imported Fill – Place, Spread Compact	22
		Excavated Fill – Place, Spread Compact	4
		Re-soil Batters – Load out from Stockpile	4
		Re-soil Batters – Spread	4
		Topsoil in Verge Fill – Load Out	6
		Topsoil in Verge Fill – Placing	6
A4019	Drainage	Excavate Balance Ponds	2
		Carrier Drainage	8
		French Drains	6
A4019	Pavement	Place Sub-Base	10
		Pavement – Slips	14
A4019	Planing of Junctions	Tie-Ins	5
Underpass	Construction	Excavate	2
		Concrete Bases to Arch	4
		Place Precast Arch units	2
		Concrete Wing Wall to Arch	4

Location	Activity	Description	Duration in weeks
Flood storage area	Earthworks	Topsoil Strip – Strip	1
		Topsoil Strip – Stockpile	1
		Resoil Batters - Load out from Stockpile	1
		Resoil Batters – Spread	1
		Excavate	24
Compound	Services	Material Handling & Distribution	75
		Structures Services	26
		Transit Tipper Maintenance	75
		Site task Lighting	50
		Miscellaneous Plant	75

- 6.9.7. The shortest distances identified between each of the selected representative receptor locations and each planned construction activity are contained in Table 6-18, where less than 300m. The minimum distances have been used to predict worst-case noise levels experienced at each assessment location for each of the main types of construction works; earthworks, drainage, pavement and planing, stockpiling, culverts, ponds, bridge structures and compounds.
- 6.9.8. Magnitudes of impact have been allocated to each assessment location per construction activity and compared with the threshold values determined from the baseline noise levels provided in Table 6-11. A determination of significance has been made in accordance with DMRB LA 111 and taking into account the duration and geographical progression of works.
- 6.9.9. Biodiversity receptors are considered in Chapter 7 – Biodiversity (application document TR010063 – APP 6.5). With regards to NPSNN compliance, it is considered that no ecological receptors are expected to be impacted by noise from the construction of the Scheme.
- 6.9.10. The predicted construction noise levels for each construction activity at distances of up to 300m are provided in Table 6-17 below. These values do not include temporary noise barriers, as the location of temporary barriers will be determined during the detailed design phase. Table 6-17 also indicates the construction works with greatest potential for a significant effect, with a legend at the end of the table to explain the colours used.

Table 6-17 - Predicted construction activity noise levels (dB) versus distance (m)

Legend										
		75.0dB L _{Aeq} or higher					55.0 to 64.9dB L _{Aeq}			
		65.0 to 74.9dB L _{Aeq}			Less than 55.0dB L _{Aeq}					
Work type	Activity	10m	25m	50m	75m	100m	150m	200m	250m	300m
Earthworks	Topsoil Strip - Strip	83.1	75.1	67.6	63.2	60.1	55.7	52.5	50.1	48.1
Stockpile	Topsoil Strip - Stockpile	77.3	69.3	61.8	57.4	54.3	49.9	46.8	44.3	42.4
Earthworks	Imported Fill - Place, Spread Compact	80.0	72.1	64.6	60.2	57.0	52.6	49.5	47.1	45.1
Earthworks	Excavated Fill - Place, Spread Compact	80.5	72.5	65.0	60.6	57.5	53.1	50.0	47.5	45.6
Stockpile	Resoil Batters - Load out from Stockpile	81.7	73.8	66.2	61.8	58.7	54.3	51.2	48.8	46.8

Legend												
		75.0dB L_{Aeq} or higher					55.0 to 64.9dB L_{Aeq}					
		65.0 to 74.9dB L_{Aeq}						Less than 55.0dB L_{Aeq}				
Work type	Activity	10m	25m	50m	75m	100m	150m	200m	250m	300m		
Earthworks	Re-soil Batters - Spread	77.3	69.3	61.8	57.4	54.3	49.9	46.8	44.3	42.4		
Earthworks	Topsoil in Verge Fill - Load Out	80.4	72.4	64.9	60.5	57.4	53.0	49.8	47.4	45.4		
Earthworks	Topsoil in Verge Fill - Placing	65.0	57.1	49.6	45.2	42.0	37.6	34.5	32.1	30.1		
Balance Ponds	Excavate Balance Ponds	82.5	74.5	67.0	62.6	59.5	55.1	52.0	49.5	47.6		
Drainage	Carrier Drainage	75.3	67.3	59.8	55.4	52.3	47.9	44.8	42.3	40.4		
Drainage	French Drains	72.6	64.6	57.1	52.7	49.6	45.2	42.1	39.6	37.7		
Culvert Extensions	Excavation of Bypass Channels/ Breakout of Existing Headwalls	71.0	63.0	55.5	51.1	48.0	43.6	40.4	38.0	36.0		
Culvert Extensions	Construction of Culverts	78.4	70.5	63.0	58.6	55.4	51.0	47.9	45.5	43.5		
Culvert Extensions	Overpumping	68.0	60.1	52.5	48.1	45.0	40.6	37.5	35.1	33.1		
Pavement and Planing	Place Sub-Base	78.4	70.5	62.9	58.5	55.4	51.0	47.9	45.5	43.5		
Pavement and Planing	Pavement – Slips/ Pavement - Gyrotory	80.9	72.9	65.4	61.0	57.9	53.5	50.4	47.9	46.0		
Pavement and Planing	Tie-Ins to M5	66.5	58.5	51.0	46.6	43.5	39.0	35.9	33.5	31.5		
Link Road	Haul Route (assume worst case 3 wagons in one hour)	81.8	73.9	66.3	61.9	58.8	54.4	51.3	48.9	46.9		
Structures - All	Piling – Platform/ Hardstanding	75.5	67.6	60.0	55.6	52.5	48.1	45.0	42.6	40.6		
Structures - Base	Piling - Install Piles	82.0	74.0	66.5	62.1	59.0	54.6	51.4	49.0	47.0		
Structures - Base	Excavate Bases/Concrete Deck	71.0	63.0	55.5	51.1	48.0	43.6	40.4	38.0	36.0		
Structures - All	Formwork - Bases/ Place Rebar/ Trestles/ Precast	67.0	59.0	51.5	47.1	44.0	39.6	36.5	34.0	32.1		

Legend												
		75.0dB L_{Aeq} or higher					55.0 to 64.9dB L_{Aeq}					
		65.0 to 74.9dB L_{Aeq}						Less than 55.0dB L_{Aeq}				
Work type	Activity	10m	25m	50m	75m	100m	150m	200m	250m	300m		
Structures – All	Concrete	69.4	61.5	54.0	49.5	46.4	42.0	38.9	36.5	34.5		
Structures - Columns	Place PC Sleeves	68.8	60.8	53.3	48.9	45.8	41.3	38.2	35.8	33.8		
Structures - Reinforced Earth Abutments	Erect PC panels, Place Fill	73.1	65.1	57.6	53.2	50.1	45.7	42.6	40.1	38.2		
Structures - Deck	Unload beams	70.0	62.1	54.6	50.2	47.0	42.6	39.5	37.1	35.1		
Flood Culverts	Excavate for Base	82.5	74.5	67.0	62.6	59.5	55.1	52.0	49.5	47.6		
Flood Culverts	Spread and compact Backfill	79.9	72.0	64.5	60.1	56.9	52.5	49.4	47.0	45.0		
Flood Culverts	Place Culvert Units	68.8	60.8	53.3	48.9	45.8	41.3	38.2	35.8	33.8		
Flood Culverts	Headwalls Concrete, Rebar, Formwork	71.0	63.0	55.5	51.1	48.0	43.6	40.4	38.0	36.0		
Underpass/ Flood storage area	Excavate	82.5	74.5	67.0	62.6	59.5	55.1	52.0	49.5	47.6		
Underpass/ Flood storage area	Concrete works	70.0	62.1	54.5	50.1	47.0	42.6	39.5	37.1	35.1		
Service Plant	Material Handling	75.0	67.0	59.5	55.1	52.0	47.6	44.4	42.0	40.0		
Service Plant	Structures Services	69.8	61.8	54.3	49.9	46.8	42.4	39.2	36.8	34.8		
Service Plant	TTM Maintenance	76.3	68.3	60.8	56.4	53.3	48.9	45.7	43.3	41.3		
Service Plant	Site task lighting	65.0	57.1	49.5	45.1	42.0	37.6	34.5	32.1	30.1		
Service Plant	Miscellaneous plant	67.9	59.9	52.4	48.0	44.9	40.5	37.4	34.9	33.0		

6.9.11. Table 6-17 shows that the construction activity generating the highest predicted noise level was the topsoil strip, with a predicted noise level of 83dB L_{Aeq} at a distance of 10 m. The lowest noise levels predicted were for top verge fill placing, with a predicted noise level of 65dB L_{Aeq} at a distance of 10 m.

- 6.9.12. Of the 38 representative receptor locations, the daytime SOAEL threshold has been established as 75dB L_{Aeq} at 9 locations, 70dB L_{Aeq} at 4 locations and 65dB L_{Aeq} for the remaining 26 representative receptor locations. Beyond 50m of the works, all activities were predicted less than 65dB L_{Aeq} , with all activities predicted less than 55dB at 150m from the works.
- 6.9.13. There are properties within 25m of the works, but the transitory nature of several of the activities within each phase means that construction noise impacts at many of the properties would only be for a short time. An assessment of significance has been made based on predicted moderate and major magnitudes of impact and the indicated timescale for construction activities responsible for generating these impacts.
- 6.9.14. It is expected that weekend, evening and night-time works will be limited to essential works only.
- 6.9.15. The distance from each of the representative properties to the works has been measured, classifying all works as earthworks, drainage, pavement and planing, stockpiling, culverts, ponds, bridge structures, services and compounds; with the highest noise level from each classification being used to determine the effect.
- 6.9.16. Table 6-18 shows the representative assessment locations that are predicted to experience adverse and significant adverse effects for all time periods, along with an indication of the benefit of a temporary noise barrier; assuming a 10dB improvement at the properties. The legend for the colour coding is provided at the end of the table.

Table 6-18 - Construction noise assessment of effects at representative properties (within 300m of works)

Legend – Worst Impact Noted at Property*										
						Minor Impact				
						Moderate Impact				
						Major Impact (SOAEL+5dB) – potential for noise insulation				
						Major Impact (SOAEL+10dB) – potential for temporary rehoming				
ID	Representative properties	LOAEL Threshold	SOAEL Threshold	Activity	Distance to Activity	Predicted Activity Noise Level (dB L _{Aeq}) at Property From Activity	Daytime activities causing adverse effects (exceeds LOAEL) without mitigation	Evening activities causing adverse effects (exceeds LOAEL) without mitigation	Night-time activities causing adverse effects (exceeds LOAEL) without mitigation	Remaining Moderate or Major impacts once mitigation in place (Day, Evening and Night)
1	Sheldon Cottages	Day - 60dB Evening - 60dB Night - 55dB	Day - 65dB Evening - 65dB Night - 55dB	Earthworks Drainage Pavement and Planing Stockpiling Culvert Piffs Elm Bridgeworks	25m 75m 75m 10m 250m 100m	75.1dB 55.4dB 61.0dB 81.7dB 45.5dB 59.0dB	Earthworks & Stockpiling – Major (SOAEL +10dB)	Earthworks & Stockpiling – Major (SOAEL +10dB)	Earthworks & Stockpiling – Major (SOAEL +10dB) Pavement and Planing – Major (SOAEL +5dB) Bridgeworks and Drainage (Moderate)	Moderate and Major adverse impact remains from road and stockpiling works (D,E,N). If work duration is likely to exceed limit, noise insulation (D,E,N) may be required.
1	Sheldon Cottages – Access Road Only	Day - 60dB Evening - 60dB Night - 55dB	Day - 65dB Evening - 65dB Night - 55dB	Earthworks Drainage Pavement and Planing	10m 10m 10m	83.1dB 75.3dB 80.9dB	Earthworks, Drainage & Pavement and Planing – Major (SOAEL +10dB)	Earthworks, Drainage & Pavement and Planing – Major (SOAEL +10dB)	Earthworks, Drainage & Pavement and Planing – Major (SOAEL +10dB)	Moderate and Major adverse impact remains from road works (D,E,N). If work duration is likely to exceed limit, noise insulation (D,E,N) or temporary rehoming (N) may be required.
2	Barn Farm	Day - 70dB Evening - 70dB Night - 65dB	Day - 75dB Evening - 70dB Night - 65dB	Earthworks Drainage Pavement and Planing Culvert	50m 50m 50m 150m	67.6dB 59.8dB 65.4dB 51.0dB	None	None	Earthworks & Pavement and Planing – Night only (Moderate)	No adverse impacts remain.
3	Informal Traveller site	Day - 70dB Evening - 70dB Night - 70dB	Day - 75dB Evening - 70dB Night - 70dB	Earthworks Drainage Pavement and Planing Stockpiling Culvert	25m 25m 25m 10m 10m	75.1dB 67.3dB 72.9dB 81.7dB 78.4dB	Stockpiling – Major (SOAEL +5dB) Earthworks & Culverts – Moderate Pavement and Planing – Minor	Stockpiling – Major (SOAEL +10dB) Earthworks & Culverts – Major (SOAEL +5dB) Pavement and Planing – Moderate	Stockpiling – Major (SOAEL +10dB) Earthworks & Culverts – Major (SOAEL +5dB) Pavement and Planing – Moderate	Moderate adverse impact from stockpiling remains (E,N). Minor adverse impact from stockpiling remains, which is not significant (D).
4	Butlers Court	Day - 60dB Evening - 60dB Night - 60dB	Day - 65dB Evening - 65dB Night - 60dB	Earthworks Drainage Pavement and Planing Stockpiling	150m 150m 150m 150m	55.7dB 47.9dB 53.5dB 54.3dB	None	None	None	No adverse impact.

ID	Representative properties	LOAEL Threshold	SOAEL Threshold	Activity	Distance to Activity	Predicted Activity Noise Level (dB L _{Aeq}) at Property From Activity	Daytime activities causing adverse effects (exceeds LOAEL) without mitigation	Evening activities causing adverse effects (exceeds LOAEL) without mitigation	Night-time activities causing adverse effects (exceeds LOAEL) without mitigation	Remaining Moderate or Major impacts once mitigation in place (Day, Evening and Night)
5	Stanboro' Cottage, Stanboro Lane	Day - 65dB Evening - 65dB Night - 65dB	Day - 70dB Evening - 65dB Night - 65dB	Earthworks Drainage Pavement and Planing Pondworks	10m 10m 10m 200m	83.1dB 75.3dB 80.9dB 52.0dB	Earthworks & Pavement and Planing – Major (SOAEL +10dB) Drainage – Major (SOAEL +5dB)	Earthworks, Drainage, Pavement and Planing, – Major (SOAEL +10dB)	Earthworks, Drainage, Pavement and Planing, – Major (SOAEL +10dB)	Moderate and Major adverse impacts from road works remain (D,E,N). If work duration is likely to exceed limit, noise insulation (E,N) may be required.
6	Stanboro, Stanboro Lane	Day - 60dB Evening - 60dB Night - 60dB	Day - 65dB Evening - 65dB Night - 60dB	Earthworks Drainage Pavement and Planing Pondworks	25m 25m 25m 100m	75.1dB 67.3dB 72.9dB 59.5dB	Earthworks – Major (SOAEL +10dB) Pavement and Planing – Major (SOAEL +5dB) Drainage – Moderate	Earthworks – Major (SOAEL +10dB) Pavement and Planing – Major (SOAEL +5dB) Drainage – Moderate	Earthworks & Pavement and Planing – Major (SOAEL +10dB) Drainage – Major (SOAEL +5dB)	Moderate and Major adverse impacts remains (D,E,N). If work duration is likely to exceed limit, noise insulation (N) may be required.
7	Butlers Court Cottages/ Mill House Farm	Day - 55dB Evening - 55dB Night - 55dB	Day - 65dB Evening - 60dB Night - 55dB	Earthworks Drainage Pavement and Planing Stockpiling River Chelt Bridge Construction Services	200m 200m 200m 100m 100m 200m	52.5dB 44.8dB 47.9dB 58.7dB 59.0dB 39.2dB	Stockpiling and Bridgeworks – Minor	Stockpiling and Bridgeworks – Minor	Stockpiling and Bridgeworks – Moderate	No adverse impacts remain.
8	Holmdale, B4634	Day - 60dB Evening - 60dB Night - 55dB	Day - 65dB Evening - 65dB Night - 55dB	Earthworks Drainage Pavement and Planing	250m 250m 250m	50.1dB 42.3dB 45.5dB	None	None	None	No adverse impact.
9	Aldreth, B4634	Day - 60dB Evening - 60dB Night - 55dB	Day - 65dB Evening - 65dB Night - 55dB	Earthworks Drainage Pavement and Planing	100m 100m 100m	60.1dB 52.4dB 57.9dB	Earthworks – Minor	Earthworks – Minor	Earthworks & Pavement and Planing – Moderate	No adverse impacts remain.
10	The House In The Tree, B4634	Day - 60dB Evening - 60dB Night - 55dB	Day - 65dB Evening - 65dB Night - 55dB	Earthworks Drainage Pavement and Planing Stockpiling Pondworks	50m 50m 50m 250m 150m	67.6dB 59.8dB 65.4dB 48.8dB 55.1dB	Earthworks & Pavement and Planing – Moderate	Earthworks & Pavement and Planing – Moderate	Earthworks & Pavement and Planing – Major (SOAEL +10dB) Pondworks & Drainage – Moderate	Moderate adverse impacts remain from Earthworks and Pavement (N).
11	Elm Cottage, B4634	Day - 60dB Evening - 60dB Night - 55dB	Day - 65dB Evening - 65dB Night - 55dB	Earthworks Drainage Pavement and Planing Stockpiling Pondworks	10m 10m 10m 200m 150m	83.1dB 75.3dB 80.9dB 51.2dB 55.1dB	Earthworks, Drainage & Pavement and Planing – Major (SOAEL +10dB)	Earthworks, Drainage & Pavement and Planing – Major (SOAEL +10dB)	Earthworks, Drainage & Pavement and Planing – Major (SOAEL +10dB) Pondworks - Moderate	Moderate and Major adverse impacts remain (D,E,N). If work duration is likely to exceed limit, noise insulation (D,E,N) or

ID	Representative properties	LOAEL Threshold	SOAEL Threshold	Activity	Distance to Activity	Predicted Activity Noise Level (dB L _{Aeq}) at Property From Activity	Daytime activities causing adverse effects (exceeds LOAEL) without mitigation	Evening activities causing adverse effects (exceeds LOAEL) without mitigation	Night-time activities causing adverse effects (exceeds LOAEL) without mitigation	Remaining Moderate or Major impacts once mitigation in place (Day, Evening and Night)
										temporary rehoming (N) may be required.
12	Barn Close, B4634	Day - 60dB Evening - 60dB Night - 55dB	Day - 65dB Evening - 65dB Night - 55dB	Earthworks Drainage Pavement and Planing Stockpiling	300m 300m 300m 150m	48.1dB 40.4dB 43.5dB 54.3dB	None	None	None	No adverse impact.
13	The Brow, B4634	Day - 60dB Evening - 60dB Night - 50dB	Day - 65dB Evening - 65dB Night - 55dB	Earthworks Drainage Pavement and Planing Stockpiling Pondworks River Chelt Bridge Construction	200m 200m 200m 150m 250m 300m	52.5dB 44.8dB 47.9dB 54.3dB 49.5dB 40.6dB	None	None	None	No adverse impact.
14	Rose Cottage, Cooks Lane	Day - 70dB Evening - 70dB Night - 65dB	Day - 75dB Evening - 70dB Night - 65dB	Earthworks Drainage Pavement and Planing Stockpiling Compound	25m 25m 25m 150m 300m	75.1dB 67.3dB 72.9dB 54.3dB 41.3dB	Earthworks – Moderate Pavement and Planing – Minor	Earthworks – Major (SOAEL +5dB) Pavement and Planing – Moderate	Earthworks – Major (SOAEL +10dB) Pavement and Planing – Major (SOAEL +5dB) Drainage – Moderate	Moderate adverse impacts remain from Earthworks (N).
15	Mayville, Cooks Lane	Day - 60dB Evening - 60dB Night - 55dB	Day - 65dB Evening - 65dB Night - 55dB	Earthworks Drainage Pavement and Planing Stockpiling	50m 50m 50m 250m	67.6dB 59.8dB 65.4dB 48.8dB	Earthworks & Pavement and Planing – Moderate	Earthworks & Pavement and Planing – Moderate	Earthworks & Pavement and Planing – Major (SOAEL +10dB) Drainage – Moderate	Moderate adverse impacts remain from Earthworks and Pavement (N).
16	Cooks Farm, Cooks Lane	Day - 60dB Evening - 60dB Night - 50dB	Day - 65dB Evening - 65dB Night - 55dB	Earthworks Drainage Pavement and Planing Stockpiling	150m 150m 150m 250m	55.7dB 47.9dB 53.5dB 48.8dB	None	None	Earthworks – Moderate Pavement and Planing – Minor	No adverse impacts remain.
17	The Nook, Cooks Lane	Day - 55dB Evening - 55dB Night - 50dB	Day - 65dB Evening - 60dB Night - 55dB	Earthworks Drainage Pavement and Planing Stockpiling	150m 150m 150m 300m	55.7dB 47.9dB 53.5dB 46.8dB	Earthworks - Minor	Earthworks - Minor	Earthworks – Moderate Pavement and Planing – Minor	No adverse impacts remain.
18	Hollybank, A4019	Day - 75dB Evening - 75dB	Day - 75dB Evening - 75dB	Earthworks Drainage Pavement and Planing	10m 10m 10m	83.1dB 75.3dB 80.9dB	Earthworks & Pavement and Planing – Major (SOAEL +5dB) Drainage - Moderate	Earthworks & Pavement and Planing – Major (SOAEL +5dB) Drainage - Moderate	Earthworks, Drainage & Pavement and Planing – Major (SOAEL +10dB)	Moderate and Major adverse impacts remain (N).

ID	Representative properties	LOAEL Threshold	SOAEL Threshold	Activity	Distance to Activity	Predicted Activity Noise Level (dB L _{Aeq}) at Property From Activity	Daytime activities causing adverse effects (exceeds LOAEL) without mitigation	Evening activities causing adverse effects (exceeds LOAEL) without mitigation	Night-time activities causing adverse effects (exceeds LOAEL) without mitigation	Remaining Moderate or Major impacts once mitigation in place (Day, Evening and Night)
		Night - 65dB	Night - 65dB	Services	250m	36.8dB				If work duration is likely to exceed limit, noise insulation (N) may be required.
19	The Green	Day - 70dB Evening - 70dB Night - 60dB	Day - 75dB Evening - 70dB Night - 65dB	Earthworks Drainage Pavement and Planing Pondworks Services	10m 10m 10m 200m 150m	83.1dB 75.3dB 80.9dB 52.0dB 42.4dB	Earthworks & Pavement and Planing – Major (SOAEL +5dB) Drainage – Moderate	Earthworks & Pavement and Planing – Major (SOAEL +10dB) Drainage – Major (SOAEL +5dB)	Earthworks, Drainage & Pavement and Planing – Major (SOAEL +10dB)	Moderate and Major adverse impacts remain (E,N). If work duration is likely to exceed limit, noise insulation (N) may be required. Minor adverse impact from the roadworks remain, which are not significant (D)
20	Cremyll, A4019	Day - 65dB Evening - 65dB Night - 55dB	Day - 70dB Evening - 65dB Night - 55dB	Earthworks Drainage Pavement and Planing Services	25m 25m 25m 150m	75.1dB 67.3dB 72.9dB 42.4dB	Earthworks – Major (SOAEL +5dB) Pavement and Planing – Moderate Drainage - Minor	Earthworks – Major (SOAEL +10dB) Pavement and Planing – Major (SOAEL +5dB) Drainage - Moderate	Earthworks, Drainage & Pavement and Planing – Major (SOAEL +10dB)	Moderate and Major adverse impacts remain (E,N). If work duration is likely to exceed limit, temporary rehousing (N) may be required. Minor adverse impact from the roadworks remain, which are not significant (D).
21	Landrean, A4019	Day - 65dB Evening - 65dB Night - 55dB	Day - 70dB Evening - 65dB Night - 55dB	Earthworks Drainage Pavement and Planing Ponds Services	25m 25m 25m 250m 75m	75.1dB 67.3dB 72.9dB 49.5dB 49.9dB	Earthworks – Major (SOAEL +5dB) Pavement and Planing – Moderate Drainage - Minor	Earthworks – Major (SOAEL +10dB) Pavement and Planing – Major (SOAEL +5dB) Drainage - Moderate	Earthworks, Drainage & Pavement and Planing – Major (SOAEL +10dB)	Moderate and Major adverse impacts remain (E,N). If work duration is likely to exceed limit, temporary rehousing (N) may be required. Minor adverse impact from the roadworks remain, which are not significant (D).
22	Linton, The Green	Day - 60dB Evening - 60dB Night - 55dB	Day - 65dB Evening - 65dB Night - 55dB	Earthworks Drainage Pavement and Planing Services	50m 50m 50m 200m	67.6dB 59.8dB 65.4dB 39.2dB	Earthworks & Pavement and Planing – Moderate	Earthworks & Pavement and Planing – Moderate	Earthworks & Pavement and Planing – Major (SOAEL +10dB) Drainage – Moderate	Moderate adverse impacts remain from Earthworks and Pavement (N).
23	Pigeon Farm Barns, The Green	Day - 60dB Evening - 60dB Night - 50dB	Day - 65dB Evening - 65dB Night - 55dB	Earthworks Drainage Pavement and Planing Services	75m 75m 75m 250m	63.2dB 55.4dB 61.0dB 36.8dB	Earthworks & Pavement and Planing – Minor	Earthworks & Pavement and Planing – Minor	Earthworks & Pavement and Planing – Major (SOAEL +5dB) Drainage – Moderate	Minor adverse impact from the roadworks remain, which are not significant (N).
24	The Old Dairy, The Green	Day - 55dB	Day - 65dB	Earthworks Drainage	100m 100m	60.1dB 52.4dB	Earthworks & Pavement and Planing – Minor	Earthworks – Moderate Pavement and Planing – Minor	Earthworks & Pavement and Planing – Moderate	Minor adverse impact from the roadworks remain, which are not significant (N).

ID	Representative properties	LOAEL Threshold	SOAEL Threshold	Activity	Distance to Activity	Predicted Activity Noise Level (dB L _{Aeq}) at Property From Activity	Daytime activities causing adverse effects (exceeds LOAEL) without mitigation	Evening activities causing adverse effects (exceeds LOAEL) without mitigation	Night-time activities causing adverse effects (exceeds LOAEL) without mitigation	Remaining Moderate or Major impacts once mitigation in place (Day, Evening and Night)
		Evening - 55dB Night - 50dB	Evening - 60dB Night - 55dB	Pavement and Planing Services	100m 250m	57.9dB 36.8dB			Drainage – Minor	
25	Uckington Farm, The Green	Day - 55dB Evening - 55dB Night - 50dB	Day - 65dB Evening - 60dB Night - 55dB	Earthworks Drainage Pavement and Planing	150m 150m 150m	55.7dB 47.9dB 53.5dB	Earthworks – Minor	Earthworks – Minor	Earthworks – Moderate Pavement and Planing – Minor	No adverse impacts remain.
26	Maple Lodge, A4019	Day - 70dB Evening - 70dB Night - 60dB	Day - 75dB Evening - 70dB Night - 65dB	Earthworks Drainage Pavement and Planing Culvert Pondworks	10m 10m 10m 150m 100m	83.1dB 75.3dB 80.9dB 51.0dB 59.5dB	Earthworks & Pavement and Planing – Major (SOAEL +5dB) Drainage – Moderate	Earthworks & Pavement and Planing – Major (SOAEL +10dB) Drainage – Major (SOAEL +5dB)	Earthworks, Drainage & Pavement and Planing – Major (SOAEL +10dB)	Moderate and Major adverse impact remains (E,N). If work duration is likely to exceed limit, noise insulation (N) may be required. Minor adverse impact from the roadworks remain, which are not significant (D).
27	Sandpiper Drive	Day - 70dB Evening - 70dB Night - 60dB	Day - 75dB Evening - 70dB Night - 65dB	Earthworks Drainage Pavement and Planing Culvert Pond	10m 10m 10m 250m 100m	83.1dB 75.3dB 80.9dB 45.5dB 59.5dB	Earthworks & Pavement and Planing – Major (SOAEL +5dB) Drainage – Moderate	Earthworks & Pavement and Planing – Major (SOAEL +10dB) Drainage – Major (SOAEL +5dB)	Earthworks, Drainage & Pavement and Planing – Major (SOAEL +10dB)	Moderate and Major adverse impact remains (E,N). If work duration is likely to exceed limit, noise insulation (N) may be required. Minor adverse impact from the roadworks remain, which are not significant (D).
28	Hilary, A4019	Day - 70dB Evening - 70dB Night - 60dB	Day - 75dB Evening - 70dB Night - 65dB	Earthworks Drainage Pavement and Planing	10m 10m 10m	83.1dB 75.3dB 80.9dB	Earthworks & Pavement and Planing – Major (SOAEL +5dB) Drainage – Moderate	Earthworks & Pavement and Planing – Major (SOAEL +10dB) Drainage – Major (SOAEL +5dB)	Earthworks, Drainage & Pavement and Planing – Major (SOAEL +10dB)	Moderate and Major adverse impact remains (E,N). If work duration is likely to exceed limit, noise insulation (N) may be required. Minor adverse impact from the roadworks remain, which are not significant (D).
29	26 Homecroft Drive	Day - 60dB Evening - 60dB Night - 50dB	Day - 65dB Evening - 65dB Night - 55dB	Earthworks Drainage Pavement and Planing Culvert Pondworks	25m 25m 25m 200m 150m	75.1dB 67.3dB 72.9dB 47.9dB 55.1dB	Earthworks – Major (SOAEL +10dB) Pavement and Planing – Major (SOAEL +5dB) Drainage – Moderate	Earthworks – Major (SOAEL +10dB) Pavement and Planing – Major (SOAEL +5dB) Drainage – Moderate	Earthworks, Drainage & Pavement and Planing – Major (SOAEL +10dB) Pondworks – Moderate	Moderate and Major adverse impact remains (D,E,N). If work duration is likely to exceed limit, temporary rehousing (N) may be required.

ID	Representative properties	LOAEL Threshold	SOAEL Threshold	Activity	Distance to Activity	Predicted Activity Noise Level (dB L _{Aeq}) at Property From Activity	Daytime activities causing adverse effects (exceeds LOAEL) without mitigation	Evening activities causing adverse effects (exceeds LOAEL) without mitigation	Night-time activities causing adverse effects (exceeds LOAEL) without mitigation	Remaining Moderate or Major impacts once mitigation in place (Day, Evening and Night)
30	23 Homecroft Drive	Day - 55dB Evening - 55dB Night - 50dB	Day - 65dB Evening - 60dB Night - 55dB	Earthworks Drainage Pavement and Planing Culvert Pondworks	50m 50m 50m 200m 200m	67.6dB 59.8dB 65.4dB 47.9dB 52.0dB	Earthworks & Pavement and Planing – Moderate Drainage - Minor	Earthworks & Pavement and Planing – Major (SOAEL +5dB) Drainage – Minor	Earthworks & Pavement and Planing – Major (SOAEL +10dB) Drainage – Major (SOAEL +5dB) Pondworks – Minor	Moderate adverse impacts remain from Earthworks and Pavement (N). Minor adverse impact from the roadworks remain, which are not significant (D,E).
31	21 Homecroft Drive	Day - 55dB Evening - 55dB Night - 50dB	Day - 65dB Evening - 60dB Night - 55dB	Earthworks Drainage Pavement and Planing Culvert Pondworks	75m 75m 75m 200m 200m	63.2dB 55.4dB 61.0dB 47.9dB 52.0dB	Earthworks, Drainage & Pavement and Planing – Minor	Earthworks & Pavement and Planing – Moderate Drainage – Minor	Earthworks & Pavement and Planing – Major (SOAEL +5dB) Drainage – Moderate Pondworks – Minor	Minor adverse impact from the roadworks remain, which are not significant (N).
32	17 Homecroft Drive	Day - 55dB Evening - 55dB Night - 50dB	Day - 65dB Evening - 60dB Night - 55dB	Earthworks Drainage Pavement and Planing Culvert Pondworks	100m 100m 100m 200m 200m	60.1dB 52.4dB 57.9dB 47.9dB 52.0dB	Earthworks & Pavement and Planing – Minor	Earthworks – Moderate Pavement and Planing – Minor	Earthworks – Major (SOAEL +5dB) Pavement and Planing – Moderate Pondworks & Drainage – Minor	Minor adverse impact from the roadworks remain, which are not significant (N).
33	14 Homecroft Drive	Day - 55dB Evening - 55dB Night - 50dB	Day - 65dB Evening - 60dB Night - 55dB	Earthworks Drainage Pavement and Planing Culvert Pondworks	150m 150m 150m 200m 200m	55.7dB 47.9dB 53.5dB 47.9dB 52.0dB	Earthworks – Minor	Earthworks – Minor	Earthworks – Moderate Pondworks & Pavement and Planing – Minor	No adverse impacts remain.
34	90 River Leys	Day - 70dB Evening - 70dB Night - 60dB	Day - 75dB Evening - 70dB Night - 65dB	Earthworks Drainage Pavement and Planing	10m 10m 10m	83.1dB 75.3dB 80.9dB	Earthworks & Pavement and Planing – Major (SOAEL +5dB) Drainage – Moderate	Earthworks & Pavement and Planing – Major (SOAEL +10dB) Drainage – Major (SOAEL +5dB)	Earthworks, Drainage & Pavement and Planing – Major (SOAEL +10dB)	Moderate and Major adverse impacts remain (E,N). If work duration is likely to exceed limit, noise insulation (N) may be required. Minor adverse impact from the roadworks remain, which are not significant (D).
35	138 River Leys	Day - 65dB Evening - 65dB Night - 55dB	Day - 70dB Evening - 65dB Night - 55dB	Earthworks Drainage Pavement and Planing	25m 25m 25m	75.1dB 67.3dB 72.9dB	Earthworks – Major (SOAEL +5dB) Pavement and Planing – Moderate Drainage – Minor	Earthworks – Major (SOAEL +10dB) Pavement and Planing – Major (SOAEL +5dB) Drainage – Moderate	Earthworks, Drainage & Pavement and Planing – Major (SOAEL +10dB)	Moderate and Major adverse impacts remain (E,N). If work duration is likely to exceed limit, temporary rehousing (N) may be required. Minor adverse impact from the roadworks remain, which are not significant (D).

ID	Representative properties	LOAEL Threshold	SOAEL Threshold	Activity	Distance to Activity	Predicted Activity Noise Level (dB L _{Aeq}) at Property From Activity	Daytime activities causing adverse effects (exceeds LOAEL) without mitigation	Evening activities causing adverse effects (exceeds LOAEL) without mitigation	Night-time activities causing adverse effects (exceeds LOAEL) without mitigation	Remaining Moderate or Major impacts once mitigation in place (Day, Evening and Night)
36	113 River Leys	Day - 60dB Evening - 60dB Night - 50dB	Day - 65dB Evening - 65dB Night - 55dB	Earthworks Drainage Pavement and Planing	50m 50m 50m	67.6dB 59.8dB 65.4dB	Earthworks & Pavement and Planing – Moderate	Earthworks & Pavement and Planing – Moderate	Earthworks & Pavement and Planing – Major (SOAEL +10dB) Drainage – Moderate	Moderate adverse impacts remain from Earthworks and Pavement (N).
37	126 River Leys	Day - 55dB Evening - 55dB Night - 50dB	Day - 65dB Evening - 60dB Night - 55dB	Earthworks Drainage Pavement and Planing	75m 75m 75m	63.2dB 55.4dB 61.0dB	Earthworks – Minor	Earthworks & Pavement and Planing – Moderate Drainage – Minor	Earthworks & Pavement and Planing – Major (SOAEL +5dB) Drainage – Moderate	Minor adverse impact from the roadworks remain, which are not significant (N).
38	45 River Leys	Day - 55dB Evening - 55dB Night - 50dB	Day - 65dB Evening - 60dB Night - 55dB	Earthworks Drainage Pavement and Planing	100m 100m 100m	60.1dB 52.4dB 57.9dB	Earthworks & Pavement and Planing – Minor	Earthworks – Moderate Pavement and Planing – Minor	Earthworks & Pavement and Planing – Moderate Drainage – Minor	Minor adverse impact from the roadworks remain (N).
39	18 River Leys	Day - 55dB Evening - 55dB Night - 50dB	Day - 65dB Evening - 60dB Night - 55dB	Earthworks Drainage Pavement and Planing	150m 150m 150m	55.7dB 47.9dB 53.5dB	Earthworks – Minor	Earthworks – Minor	Earthworks – Moderate Pavement and Planing – Minor	No adverse impacts remain.

- 6.9.17. The table demonstrates that there are activities that consistently lead to major adverse impacts at properties which are 10m to 25m from one of the representative NSR. This includes earthworks, pavement, stockpiling. Properties that are particularly at risk are those close to the A4019, East of the M5 as well as properties close to the Link Road and any new access roads to individual properties.
- 6.9.18. With mitigation in place, as well as good community engagement and limiting works to daytime wherever possible, the impact of the construction noise will be very limited. During the day two of the representative properties are predicted to exceed the threshold value for a moderate adverse impact (Stanboro' and Stanboro' Cottage), and two of which would exceed the major impact threshold for noise insulation (Sheldon Cottages and Elm Cottage), all as a result of the limited changes to local roads, rather than the A4019.
- 6.9.19. In the evening this would increase to 14 properties, with one additional representative property exceeding the threshold for noise insulation (Stanboro' Cottage). At night-time the number of moderate and major exceedances increases to twenty of the representative properties, with five properties exceeding the threshold for noise insulation, Hollybank, The Green, Maple Lodge, Sandpiper Drive, Hilary and Landrean, plus the properties at River Leys that are 10m from the works. Additionally, there are six representative properties exceeding the threshold for temporary rehousing. These properties are located at Sheldon Cottages, Elm Cottage, Stanboro' and Cremyll. and the properties at River Leys and Homecroft Drive that are 25m from the works.
- 6.9.20. Although the noise levels are predicted to exceed the threshold for a moderate and major impact at a number of the representative properties, this would not automatically lead to a significant effect, as the duration of the works must be taken into account. The duration threshold for a significant effect is 10 or more days or nights in any 15 consecutive days or nights, or a total number of days exceeding 40 in any 6 consecutive months.
- 6.9.21. In most cases, the roadworks that are very close to a residential property will be transitory in nature and it is unlikely that plant would be consistently working at that distance. Similarly, although the edge of the stockpiling may be within 25m of a property, the stockpiling area is large and the work will not take place solely at that distance. In this case large stockpiles may be effective at screening noise from elsewhere on the site.
- 6.9.22. Based on a worst case scenario assessment it is considered that the moderate or major works would not exceed the duration threshold due to the nature of the works. Therefore, construction noise is unlikely to lead to significant effect, including temporary rehousing or noise insulation.

Green Spaces and Footpaths

- 6.9.23. In addition to the construction noise assessment at the NSR buildings, the assessment has also been carried out for green areas within the study area, used for relaxation and leisure. The town centre parks and many of the countryside walks are well beyond 300m from the works, but there are a number of footpaths and public rights of way within the study area.
- 6.9.24. Only the daytime noise impacts in these green areas have been considered appropriate for leisure and relaxation. Sections of footpaths that are less than 200m from the A4019 and 600m from the M5, are already in areas that exceed 55dB (the Operational LOAEL), as determined through the operational assessment, and are less likely to be used for relaxation and leisure.
- 6.9.25. It is predicted that all construction noise levels beyond 150m from the works would not be adverse or significant, but may still be perceptible.
- 6.9.26. On footpaths that are close to the works, noise levels are likely to increase. In particular, the footpaths which cross the Link Road during its construction period will be affected by an increase in noise. However, assuming a walking speed of 3km/h, the exposure duration will be limited and walkers will be able to avoid the works or move somewhere quieter relatively quickly. The locations of the potential significant adverse effects for each phase of construction are shown in Figure 6-4 of Appendix 6.1 (application document TR010063 – APP 6.15).

Construction vibration

- 6.9.27. This part of the assessment considers the effects of ground borne vibration on key receptor locations during construction activities that feature piling, vibratory soil compaction, and asphalt rolling.
- 6.9.28. The construction activities associated with vibration are:
- Piling (Structures such as River Chelt Bridge).
 - Casting pile caps (Structures such as River Chelt Bridge).
 - Earthworks (All roads, culverts and ponds).
 - Road surfacing (All roads and pathways).
 - Underpass works (The underpass).
 - Compound set-up (The compounds).
- 6.9.29. It is understood that rotary bored piling will be used for all structures as the preferred method of piling for the Scheme. However, the vibration levels for percussive piling have been included in Table 6-19 for comparison with rotary bored piling. The table shows the predicted peak particle vibration (PPV) levels in mm/s attributed to both piling methods at various distances, as well as the predicted vibration levels from compaction activities associated with the remaining works.

Table 6-19 - Predicted peak particle vibration (PPV) levels attributed to construction activities (mm/s)

Legend									
	10 mm/s or higher						1.0 to 9.9 mm/s		
	0.3 to 0.9 mm/s						Less than 0.3 mm/s		
Activity	10m	25m	50m	75m	100m	150m	200m	250m	300m
Percussive Piling	21.8	6.7	2.7	1.6	1.1	0.6	0.4	0.3	0.3
Rotary Bored Piling	1.1	0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Compaction	3.7	1.0	0.4	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3

- 6.9.30. It can be seen in Table 6-19 that the LOAEL threshold would be exceeded at distances closer than 25m during the preferred method of piling; rotary bored piling. There are no NSR within 25m of the structures that would remain with the Scheme.
- 6.9.31. The SOAEL threshold would be exceeded at distances within 10m of rotary bored piling sites. As the closest vibration sensitive receptor is situated 100m from the nearest piling activity (Withybridge Lane), the SOAEL is not predicted to be exceeded at vibration sensitive receptors. The anticipated PPV levels for rotary bored piling are considerably lower than those required for cosmetic damage to buildings stated in Table 6-5.
- 6.9.32. Table 6-19 shows that, for percussive piling method, the SOAEL threshold would be exceeded at vibration sensitive receptors beyond 100m of the piling sites. This is of particular relevance during the construction of the River Chelt Bridge as the nearest properties to piling works are expected to be around 100m away, so the use of percussive piling should be avoided, as a moderate (and significant impact) would be predicted. However, it is unlikely that percussive piling would result in building damage due to the distance from the works.
- 6.9.33. There will be twenty piles, of 1.0m diameter each, for the construction of the River Chelt Bridge and thirty six piles, of 1.2m diameter each, for the construction of the Piffs Elm Bridges. The boring duration to do one pile per rig is around 1 day, but the number of rigs that would be operational at any one time is not known. Therefore, the duration of piling works is considered to be short-term only, due to the nature of the works.

- 6.9.34. Table 6-19 also includes predictions of vibration from compaction, using the information from the Assumptions Section. It can be seen that there is the potential for vibration from compaction to be perceptible within 75m of the works.
- 6.9.35. The SOAEL threshold would be exceeded at vibration sensitive receptors closer than 25m during various compaction works.
- 6.9.36. Compaction works are planned for all new and altered sections of the M5, A4019, access roads and the Link Road. It can be seen in Table 6-19 that vibration levels from compaction works are below those provided in BS 5228 Part 2 (Annex B.4.4) for underground services and that impacts from compaction works are unlikely.
- 6.9.37. A significant adverse effect can be determined when the vibration threshold, for a moderate or major impact, has been exceeded along with the duration threshold; which is 10 or more days or nights in any 15 consecutive days or nights, or a total number of days exceeding 40 in any 6 consecutive months.
- 6.9.38. No major construction vibration impacts have been predicted, with moderate impacts predicted at all properties within 25m of the works. In Table 6-3 it states that it is likely that vibration of this moderate level in residential environments will cause complaint, but can be tolerated if prior warning and explanation is given to the residents. So given the transitory nature of the works, the impact can be managed through good community liaison and is not considered to be a significant effect.
- 6.9.39. Vibration sensitive receptors that were predicted to experience potential adverse vibration effects attributed to piling and vibratory compaction are provided in Table 6-20.

Table 6-20 - Assessment receptors predicted to experience adverse effects of construction vibration

Representative properties	Adverse effects of vibration resulting from piling	Adverse effects of vibration resulting from compaction	Vibration Significance Threshold Exceeded
Sheldon Cottages	Property is 100m from Piffs Elm Bridge where percussive piling would cause moderate impact.	Moderate – 10m from access road	Yes
Barn Farm	None	Minor - 50m from M5	None
Informal Traveller site	None	Moderate - 25m from M5	Yes
Butlers Court	None	None	None
Stanboro' Cottage, Stanboro Lane	None	Moderate – 10m from A4019	Yes
Stanboro, Stanboro Lane	None	Moderate – 25m from A4019	Yes
Butlers Court Cottages/ Mill House Farm	Property is 100m from River Chelt Bridge where percussive piling would cause moderate impact.	None	None
Holmdale, B4634	None	None	None
Aldreth, B4634	None	None	None
The House In The Tree, B4634	None	Minor - 50m from Link Road	None
Elm Cottage, B4634	None	Moderate – 10m from Link Road	Yes

Representative properties	Adverse effects of vibration resulting from piling	Adverse effects of vibration resulting from compaction	Vibration Significance Threshold Exceeded
Barn Close, B4634	None	None	None
The Brow, B4634	None	None	None
Rose Cottage, Cooks Lane	None	Moderate – 25m from A4019	Yes
Mayville, Cooks Lane	None	Minor - 50m from Link Road	None
Cooks Farm, Cooks Lane	None	None	None
The Nook, Cooks Lane	None	None	None
Hollybank, A4019	None	Moderate – 10m from A4019	Yes
The Green	None	Moderate – 10m from A4019	Yes
Cremyll, A4019	None	Moderate – 25m from A4019	Yes
Landrean, A4019	None	Moderate – 25m from A4019	Yes
Linton, The Green	None	Minor - 50m from A4019	None
Pigeon Farm Barns, The Green	None	Minor - 75m from A4019	None
The Old Dairy, The Green	None	None	None
Uckington Farm, The Green	None	None	None
Maple Lodge, A4019	None	Moderate – 10m from A4019	Yes
Sandpiper Drive	None	Moderate – 10m from A4019	Yes
Hilary, A4019	None	Moderate – 10m from A4019	Yes
26 Homecroft Drive	None	Moderate – 25m from A4019	Yes
23 Homecroft Drive	None	Minor - 50m from A4019	None
21 Homecroft Drive	None	Minor - 75m from A4019	None
17 Homecroft Drive	None	None	None
14 Homecroft Drive	None	None	None
90 River Leys	None	Moderate – 10m from A4019	Yes

Representative properties	Adverse effects of vibration resulting from piling	Adverse effects of vibration resulting from compaction	Vibration Significance Threshold Exceeded
138 River Leys	None	Moderate – 25m from A4019	Yes
113 River Leys	None	Minor - 50m from A4019	None
126 River Leys	None	Minor - 75m from A4019	None
45 River Leys	None	None	None
18 River Leys	None	None	None

Construction traffic and diversion routes

- 6.9.40. There may be changes in traffic flows and speeds on the local roads during construction as a result of temporary traffic management measures and/or additional vehicles travelling to and from the construction site transporting materials, plant, and labour.
- 6.9.41. In accordance with DMRB LA 111 methodology, BNL calculations were performed using HDV movement data supplied by the project team and combined with the modelled Do Minimum opening year (DMOY) traffic data. This allowed the resulting change in noise level at 10m from kerbside to be calculated along potential construction traffic routes.
- 6.9.42. The DMOY traffic flows on the M5 and A4019 are around 100,000 vehicles and 20,000 vehicles per day respectively. If the number of HDV per day increased by 3500 HDV on the A4019, this would lead to a moderate and significant increase in noise. However, the worst-case predictions of less than 200 additional HDV per day during the construction phase would lead to negligible magnitudes of impact when comparing the BNLs of the DMOY scenario to DMOY scenario with construction traffic. The construction traffic assumptions are taken from Chapter 5 - Air Quality (application document TR010063 – APP 6.3)
- 6.9.43. This is attributable to the existing high volume of traffic in the area, effectively masking noise from the relatively few vehicles involved in the construction process. In addition, construction vehicle movements to construct the Link Road are planned to take place off the existing road network and within the footprint to the Scheme. As these movements are 'off network', they were considered as part of the construction activity assessment and has been addressed above.
- 6.9.44. With regard to diversion routes, the closure of the M5 will be required when the two new bridge decks are being positioned at the junction, and the existing A4019 overbridge is demolished. It is expected that the closure would take approximately twelve hours for each structure and would happen overnight, limiting the diversion of motorway traffic onto the local road network.
- 6.9.45. In accordance with DMRB LA 111, the proportionate approach has been undertaken, which has determined that the night-time closure of the M5, is highly likely to cause disturbance to receptors within 25m of the road. However, as the motorway closure is limited to three nights, the Scheme will not meet the required duration to constitute a significant adverse effect; 10 or more nights in any 15 consecutive nights.
- 6.9.46. Closure of the two slip roads at Junction 10 will be longer, for 15 months for the northbound on slip and 9 months for the southbound off slip, with an overlap of 5 months when both slip roads are closed.
- 6.9.47. DMRB LA 111 specifies that the proportionate approach should be used when a project requires full carriageway closures. Since the slip roads only carry 10% of the M5 traffic, a sensitivity assessment has been undertaken to understand the likely traffic impacts arising from the changes to the access of the M5 at J10 via the slip roads.
- 6.9.48. The changes in 'basic noise level' (BNL) due to diversion traffic were calculated for roads within the diversion traffic study area using the methodology found in CRTN or the Noise Advisory Council's "Guide to Measurement and Prediction of the Equivalent Continuous Sound Level L_{eq} " (1978) when traffic flows were outside the validity of CRTN, and the traffic

scenario with each of the slip road closure scenarios was compared with the Do-Minimum traffic scenario, for the same traffic network as used in the operational assessment.

- 6.9.49. Predicted changes that are Moderate or Major are considered to be potentially significant, although these changes are not significant in the long term as limited to the duration of the slip road closures. Table 6-21 provides the details of the significant noise changes in each scenario, as well as the minor changes on the official diversion route.

Table 6-21 - Assessment of noise impacts from road closures during the construction period

Road Name	Predicted Change in Noise			Comments
	Northbound Slip Road Closure	Southbound Slip Road Closure	Both Slip Road Closures	
B4079 Pamington Lane	Daytime: 3dB Night-time: <3dB	Daytime: 4dB Night-time: 4dB	Daytime: 5dB Night-time: 5dB	Minor to Major Impact – Temporary Significant Adverse Effect, with major adverse with both slips closed only.
The Green/ Road through Elmstone Hardwicke	Daytime: 6dB Night-time: 6dB	Daytime: 3dB Night-time: <3dB	Daytime: 6dB Night-time: 6dB	Minor to Major Impact – Temporary Significant Adverse Effect, with major adverse with both slips closed and northbound slip closed.
The Road through Boddington/ Staverton	Daytime: 7dB Night-time: 7dB	Daytime: 6dB Night-time: 7dB	Daytime: 6dB Night-time: 7dB	Major Impact – Temporary Significant Adverse Effect, in all scenarios.
A4019 Gloucester Old Spot to Hayden Road	Daytime: -3dB to -10dB Night-time: -3dB to -10dB	Daytime: -3dB to -7dB Night-time: -3dB to -8dB	Daytime: -3dB to -10dB Night-time: -3dB to -10dB	Moderate to Major Beneficial Impact, in all scenarios.
Walton Cardiff Road	Daytime: <1dB Night-time <1dB	Daytime: -10dB Night-time <1dB	Daytime: -10dB Night-time <1dB	Major Beneficial Impact in Daytime with both slips closed and southbound slip closed.
St James' Square	Daytime: -6dB Night-time: -16dB	Daytime: >-3dB Night-time: -12dB	Daytime: -6dB Night-time: -17dB	Major Beneficial Impact, in all scenarios.
Lansdown Road	Daytime: <1dB Night-time: -10dB	Daytime: <1dB Night-time: <1dB	Daytime: <1dB Night-time: >-3dB	Major Beneficial Impact with Northbound Slip Closure and minor beneficial impact with both slips closed.
A38 Jubilee Way	Daytime: <1dB Night-time: <1dB	Daytime: <1dB Night-time: <1dB	Daytime: 1dB to 2dB Night-time: 1dB to 2dB	Minor Adverse Impact on official diversion route with both slips closed only.

- 6.9.50. The maps showing the changes in noise due to the diversion routes can be found in Figures 6-18 to 6-23 in Appendix 6.1 (application document TR010063 - APP 6.15).

Operation

- 6.9.51. Detailed noise predictions within 600m of the Scheme and bypassed routes were carried out for the NSR detailed in Table 6-22. Figure 6-5 of Appendix 6.1 (application

document TR010063 – APP 6.15) shows the geographic location of the receptors within the study area.

Table 6-22 - Noise sensitive receptors included in operational road traffic noise modelling

Receptor type	Daytime Do Minimum	Daytime Do Something	Night-time Do Minimum	Night-time Do Something
Accommodation and Residential	13,818	13,777	13,818	13,777
All other sensitive receptors	570	568	40	40
Total	14,404	14,388	13,858	13,817

6.9.52. The number of residential properties is lower in the Do Something scenarios due to approximately thirty properties being demolished as part of the Scheme. A greater number of noise sensitive receptors are included in the assessment of daytime impacts as several of the non-residential receptors are not in use at night and are therefore not considered to be noise sensitive during this time period.

6.9.53. The same study area was used for Traffic Scenario S and Scenario R, where the number of receptors is the same. The strategic development sites including the safeguarded land to the north-west of Cheltenham, the North West Cheltenham Development Area and the West Cheltenham Development Area have not been modelled as individual receptors, as the detailed information for the site is not available, and the strategic development sites are dependent on transport infrastructure improvements that will be delivered by the Scheme. Without the Scheme layout it is not possible to determine anything other than the absolute noise levels at the edge of the site. Intervening buildings will act as screening for properties that are further back from the road. The assessment of absolute noise levels is covered in the cumulative assessment of the Scheme, for Traffic Scenario R.

6.9.54. The following sections detail the short-term and long-term impacts of the Scheme, where comparisons are made between the Do Minimum and Do Something scenarios in the opening year and the future year. Long-term impacts without the Scheme are also considered.

6.9.55. The predicted daytime and night-time road traffic noise levels for a selection of representative properties are shown in Table 6-39 of Appendix 6.1 (application document TR010063 – APP 6.15).

Short term impacts

6.9.56. To appraise the noise impacts of the Scheme in the opening year, a comparison has been made between the noise model results of the Do Something 2027 scenario, inclusive of mitigation, vs the Do Minimum 2027 scenario for daytime and night-time. The assessment classifies each ‘residential property’ and ‘other sensitive receptor’ according to the magnitude of impact identified using the methodology found in the DMRB LA 111. The magnitude of these opening year (short-term) noise impacts are summarised in Table 6-23 below.

Table 6-23 - Short-term daytime traffic noise impacts

Increase/decrease in noise	Change in noise level dB L _{A10,18h} /L _{night}	Magnitude of Impact	Daytime - Number of residential properties	Daytime - Number of other sensitive receptors	Night-time Number of residential properties	Night-time Number of other sensitive receptors
Increase	1 - 2.9	Minor	410	10	308	0
Increase	3 - 4.9	Moderate	4	0	0	0
Increase	>=5	Major	0	0	0	0

Negligible	-0.9 - 0.9	Negligible	12446	514	12906	40
Decrease	1 - 2.9	Minor	773	32	465	0
Decrease	3 - 4.9	Moderate	95	10	61	0
Decrease	>=5	Major	49	2	37	0

- 6.9.57. Table 6-23 demonstrates that most receptors will experience a negligible change in road traffic noise level over the short-term due to the Scheme, although there are fewer negligible changes in the night-time.
- 6.9.58. There are 773 residential properties during the day and 465 during the night-time that were predicted to experience a minor beneficial impact upon opening. This is due to traffic using the new M5 J10 Junction, rather than the local roads such as the B4634, B4063 and A4013. In the night-time period, the affected roads are the same, but the number of properties experiencing a minor change in noise is smaller.
- 6.9.59. There are 95 residential properties during the day and 61 residential properties during the night-time that are predicted to experience a moderate beneficial impact upon opening. These properties are located alongside the A4019, including the Hayden Road Junction, and also on Hayden Lane, Withybridge Lane and Bamfurlong Lane. The changes are as a direct result of the Scheme, such as the changes to the alignment of the road and the proposed noise barriers, or changes in traffic distribution. The night-time changes are in the same areas, but there are a smaller number of properties affected by a moderate decrease.
- 6.9.60. There are 49 residential properties during the daytime and 37 residential properties during the night-time that are predicted to experience major beneficial impacts upon opening of the Scheme. These residential properties are located along the A4019 and on Hayden Lane, all as a result of the changes to the Scheme, including the Link Road. The number of changes is slightly lower at night.
- 6.9.61. There are 32 non-residential sensitive receptors predicted a minor beneficial impact during the daytime. Ten have been predicted to experience a moderate beneficial impact during the day, including 7 non-sensitive buildings, such as pubs and bars in St James Square, plus Cheltenham West Community Fire Station and The House In The Tree pub. There were two major beneficial impacts at non-residential properties predicted due to the Scheme during the day at Aldi and L A Fitness, on the A4019.
- 6.9.62. Adverse impacts are predicted in the short-term upon opening of the Scheme due to changes in traffic flow on the network and changes to the alignment, such as the road moving closer to the NSR.
- 6.9.63. There are 410 residential properties that are predicted to experience a minor adverse impact due to the Scheme upon opening during the day and 308 at night. These are located on A4019, Stoke Road, Up Hatherley Way and Brooklyn Road. Four residential properties are predicted to experience a moderate adverse impact due to the Scheme upon opening, in both the daytime and night-time. These properties are located at Newhouse Farm on Moat Lane, and properties on Stoke Road including 6 Westfield Cottage, Hardwicke House and Bramble Cottage. There are no major increases predicted at residential NSRs.
- 6.9.64. There are 10 daytime minor increases at non-residential sensitive receptors upon opening due to the Scheme. The affected non-residential properties do not have specific sensitivities to noise and do not require additional assessment.
- 6.9.65. The assessment of the significance of effect at these NSRs will be discussed later in the chapter, within 6.9.85.

Long term impacts (Traffic Scenario S)

- 6.9.66. To appraise the future year noise impacts of the Scheme a comparison has been made between the noise model results of the Do Something 2042 scenario vs the Do Minimum 2027 scenario (Traffic Scenario S). The magnitude of these future year (long-term) noise impacts are summarised in Table 6-24.

Table 6-24 - Long-term daytime traffic noise impacts

Increase/ decrease in noise	Change in noise level dB L _{A10,18h} / L _{night}	Magnitude of Impact	Daytime - Number of residential properties	Daytime - Number of other sensitive receptors	Night-time Number of residential properties	Night-time Number of other sensitive receptors
Increase	3 - 4.9	Minor	4	0	0	0
Increase	5 - 9.9	Moderate	0	0	0	0
Increase	>=10	Major	0	0	0	0
Negligible	-2.9 - 2.9	Negligible	13649	557	13689	40
Decrease	3 - 4.9	Minor	78	9	51	0
Decrease	5 - 9.9	Moderate	45	2	37	0
Decrease	>=10	Major	1	0	0	0

- 6.9.67. Table 6-24 demonstrates that, within the study area, the majority of receptors are predicted to experience a negligible change due to the Scheme over the long-term.
- 6.9.68. There are 78 residential properties that are predicted to experience a minor beneficial impact due to the Scheme over the long-term. Several of these residential properties are located alongside the A4019, the M5 (Barn Farm and the informal Traveller site) and Withybridge Lane/Hayden Lane, where the beneficial change is attributed to the new Scheme alignment and proposed noise barriers. At night there are 51 residential properties predicted a minor benefit, in the same areas as during the day.
- 6.9.69. There are 45 residential properties predicted to experience moderate beneficial impacts upon opening of the Scheme during the day, and these are located along the A4019, all as the direct result of the changes to the Scheme, such as the changes to the alignment of the road and the new noise barriers. At night the number of residential properties, with moderate beneficial changes is 37. There is 1 property that is predicted a major noise benefit in the daytime, located on the A4019 behind the proposed noise barriers at Cooks Lane and the A4019. At night there are no properties that are predicted a major noise benefit in the long term.
- 6.9.70. There are nine non-residential sensitive receptors predicted to experience a minor beneficial impact and 2 predicted moderate beneficial impact due to the Scheme in the daytime. These Aldi and L A Fitness on the A4019 as moderate and non-residential properties within St James Square, the Cheltenham West Community Fire Station, Gallagher Retail Park and The House In The Tree pub as minor.
- 6.9.71. Adverse impacts are predicted at some locations in the long-term with the Scheme due to changes in traffic flow and alignment, when compared with the Do Minimum in the opening year.
- 6.9.72. There are four residential properties that are predicted to experience a minor adverse impact due to the Scheme in the long-term during the day. This includes Newhouse Farm on Moat Lane, and properties on Stoke Road including 6 Westfield Cottage, Hardwicke House and Bramble Cottage, which were predicted a moderate increase in the short-term.
- 6.9.73. No further residential properties are predicted to experience an impact due to the Scheme by the future year during the day or night.
- 6.9.74. There are no increases predicted at a non-residential sensitive receptors by the future year due to the Scheme.
- 6.9.75. Figure 6-8 and Figure 6-13 of Appendix 6.1 (application document TR010063 – APP 6.15) provide the future year Do Something noise contour maps, for the daytime and night-time, and also demonstrate the locations of LOAEL and SOAEL exceedances.

Do Minimum Impacts

6.9.76. The Do Minimum changes in noise between the opening year 2027 and the future year 2042 have been compared and the magnitude of these Do Minimum noise impacts are summarised in Table 6-25.

Table 6-25 - Do Minimum daytime traffic noise impacts

Increase/ decrease in noise	Change in noise level dB L _{A10,18h} / L _{night}	Magnitude of Impact	Daytime - Number of residential properties	Daytime - Number of other sensitive receptors	Night-time Number of residential properties	Night-time Number of other sensitive receptors
Increase	3 - 4.9	Minor	4	0	0	0
Increase	5 - 9.9	Moderate	0	0	0	0
Increase	>=10	Major	0	0	0	0
Negligible	-2.9 - 2.9	Negligible	13821	576	13825	40
Decrease	3 - 4.9	Minor	0	0	0	0
Decrease	5 - 9.9	Moderate	0	0	0	0
Decrease	>=10	Major	0	0	0	0

6.9.77. The results of the Do Minimum 2027 vs Do Minimum 2042 comparison, in Table 6-25 show that almost all predicted changes in noise are negligible. There are no decreases in noise during the day or night-time period.

6.9.78. During the day, there are 4 residential properties with a minor increase on Boddington Road. There are no increases at night or at non-residential properties.

6.9.79. There are no minor, moderate or major reductions in noise predicted in the long-term without the Scheme at any non-residential receptors. Figure 6-7 and Figure 6-12 of Appendix 6.1 (application document TR010063 – APP 6.15) provide the future year Do Minimum noise contour maps, for the daytime and night-time, and also demonstrate the locations of LOAEL and SOAEL exceedances.

6.9.80. Figure 6-5, Figure 6-6, Figure 6-10 and Figure 6-11 of Appendix 6.1 (application document TR010063 – APP 6.15) provide the opening year noise contour maps, for the daytime and night-time, and also demonstrate the locations of LOAEL and SOAEL exceedances.

Green Spaces and Footpaths

6.9.81. In addition to the operational noise assessment at the NSR buildings, the assessment has also been carried out for green areas within the study area used for relaxation and leisure. Within Cheltenham Town Centre there is Hesters Way Park, Springfields Park, St Peters Park Chelt Walk and St Mark's Recreation Ground, plus the footpaths and public rights of way around the A4019 and M5. The noise levels within these spaces remain below 50dB L_{A10,18hr} in all scenarios, with any changes in noise being negligible. In addition, the walking routes which are around the A4019 and M5 generally experience noise levels that are below 55dB once 200 to 300m from the A4019 and 600m from the M5.

6.9.82. Only the daytime noise impacts have been considered, where the footpaths which are already in areas that exceed 55dB (LOAEL) have been ignored. This includes at least an area in all of the green spaces within the town centre and all footpaths less than 200m from the A4019 and 600m from the M5, as determined through the operational assessment.

6.9.83. It was predicted that all operational changes in noise within these green areas and the majority of the footpaths were negligible and remained below the LOAEL.

6.9.84. On footpaths that are close to the works, noise levels are likely to increase, and the area less than the LOAEL is likely to reduce by around 40m. In addition, the footpaths which

cross the Link Road during its construction period will be affected by a large increase in noise. However, assuming a walking speed of 3km/h, the exposure duration will be limited.

Assessment of significance

- 6.9.85. The changes in road traffic noise predicted to result from the Scheme have been reported in accordance with DMRB LA 111 and include the mitigation measures described in the Mitigation Section.
- 6.9.86. An initial assessment of the daytime and night-time short-term operational noise significance in EIA terms at NSRs is summarised in this section and in Table 6-26 where a moderate or major magnitude of impact at NSRs are classed as ‘Significant’.

Table 6-26 - Summary of the initial assessment of short-term operational noise significance 2027

Initial assessment of operational noise significance	Number of receptors where operational noise is significant - Adverse	Number of receptors where operational noise is significant - Beneficial
Significant - Day	4	144
Not Significant - Day	3021	10506
Significant - Night	0	98
Not Significant - Night	3732	9827

- 6.9.87. Table 6-26 demonstrates that, for most of the NSRs within the operational study area, the adverse effects associated with the change in road traffic noise due to the Scheme are not significant in EIA terms.
- 6.9.88. The four properties with an initial significant daytime adverse effect in the short-term are Newhouse Farm on Moat Lane, and properties on Stoke Road including 6 Westfield Cottage, Hardwicke House and Bramble Cottage. In the long-term a minor change is not predicted at these properties, which is not considered significant.
- 6.9.89. For comparison, the initial assessment of the daytime and night-time long-term operational noise significance in EIA terms at NSRs is summarised in Table 6-27.

Table 6-27 - Summary of the initial assessment of long-term operational noise significance (Scenario S) 2043

Initial assessment of operational noise significance	Number of receptors where operational noise is significant - Adverse	Number of receptors where operational noise is significant - Beneficial
Significant - Day	0	46
Not Significant - Day	4742	8832
Significant - Night	0	37
Not Significant - Night	5236	8335

- 6.9.90. As described in the Methodology Section, a significant adverse effect, in EIA terms, occurs if any of the following conditions are met:
- A moderate or major change to road traffic noise levels is predicted,
 - The predicted noise levels with the Scheme increase by at least 1dB in the short-term and exceed the SOAEL, or
 - Contextual factors in combination with the predicted noise levels are considered to constitute a significant adverse effect.
- 6.9.91. Table 6-27 demonstrates that without taking into account all of the contextual factors, there would be no daytime significant adverse effects due to the Scheme, as the DMRB LA 111 states that where the long-term impact is predicted to be less than the short-term impact

it is appropriate to conclude that a moderate or major change in the short-term is not significant.

- 6.9.92. However, the assessment determined that there are over 164 properties with a minor adverse increase in noise which exceeds the SOAEL. Of these, 90 only exceed the SOAEL in the night-time period, and not in the daytime period. In situations where the short-term change in noise at a property does not meet the criteria for a significant change, but there is a long-term minor increase above SOAEL, this has not been considered to be a significant change in noise.
- 6.9.93. The predicted changes in noise have been reviewed alongside the absolute noise levels at the receptors and the overall site context, to arrive at a conclusion on the potential significance of the predicted changes in noise.
- 6.9.94. For example, where a potentially significant effect has been determined and occurs in both the 'With Scheme' and 'Without Scheme' long term assessment, it can be determined that the change is not as a result of the Scheme.
- 6.9.95. There have been some benefits caused by the design of the scheme, such as at Sheldon Cottages, where the new slip road screens the noise from the M5. However, houses can act as screening for properties further back from the road, and where properties have been demolished, this could lead to a significant adverse effect at those properties further back, such as New House Farm on Moat Lane.
- 6.9.96. In addition, consideration should be given to new bypass routes, such as the new Link Road. The new road would create a source of noise affecting the façade of buildings that are currently quiet. However, the minor noise benefit from the reduction in traffic on Withybridge Lane, (above SOAEL), should outweigh the minor noise increase from the Link Road, as overall the noise levels at this location are reducing.
- 6.9.97. The measures to mitigate noise on Stoke Road that will be investigated by GCC as a separate project, should also take into account the potential changes to the acoustic character. Traffic calming measures are likely to reduce the traffic noise overall, due to a reduction in traffic volume or speed. However, care should be given to the location of the measures in order to avoid acoustic features such as car body rattles over bumps or start-stop traffic.
- 6.9.98. With regard to human health and amenity, where there is a house with only windows or a garden fronting the road, they would be at more risk from a significant adverse noise effect than a property with windows and garden on a quieter façade. When assessing noise in a larger area this is more difficult to determine, but has been considered for smaller clusters of properties. In addition, the assessment has taken into account whether a property has moved from being above the SOAEL to below the SOAEL, and vice versa.
- 6.9.99. The receptors have been separated into areas with similar themes and the predicted changes in noise have been reviewed alongside the absolute noise levels at those receptors, along with the overall site context, to arrive at a conclusion on the potential significance of the predicted changes in noise.
- 6.9.100. This assessment of the significance of environmental effects takes into account both the long term and short-term assessment, as a combination of both the daytime and night-time effects and is summarised in Table 6-28, where a key for the table is at the end.
- 6.9.101. Potential qualification for noise insulation has not been used to reduce the significance of impacts. The residential properties which meet the criteria for significance are shown in Figure 6-15 and Figure 6-16 of Appendix 6.1 (application document TR010063 – APP 6.15).

Noise Important Areas Assessment

- 6.9.102. The NIAs have been identified as areas where noise levels are already very high and ameliorative action is required by the responsible authority.
- 6.9.103. However, the changes in noise at all of the NIA with the Scheme were predicted to be negligible or a beneficial change. The properties within the NIA 3950, NIA 3949 and NIA 3948, situated alongside the A4019, are predicted a moderate benefit by the future year, due to the Scheme alignment and noise barriers.

- 6.9.104. Sheldon Cottages, within NIA 3951, are predicted a minor benefit by the future year, as a result of the new slip road screening the noise from the M5.
- 6.9.105. In addition, reductions in traffic volume result in minor benefits to noise levels at some properties on Princess Elizabeth Way, within NIA 3945, NIA 3946 and NIA 3894.

Noise Insulation Regulations

- 6.9.106. Based on the predicted road traffic noise levels and impact magnitudes described above, there are three properties that may be eligible for an offer of noise insulation under the Noise Insulation (Amended) Regulations 1988. These residential properties are the Gloucester Old Spot, Stanboro Cottage Annex and Stanboro Cottage.
- 6.9.107. Each of the three properties are located on the A4019 west of the M5 Junction 10, in all cases, the properties on the road are accessed from the road, making mitigation difficult.
- 6.9.108. The eligibility at these properties is dependent on qualifying facades with rooms where noise insulation would be applicable.
- 6.9.109. No formal offers of noise insulation can be made until after the completion of the statutory processes and the finalisation of the detailed engineering design of the Scheme.

Table 6-28 - Assessment of significant environmental effects – Traffic Scenario S

Legend – Significant Effect					
		Significant Adverse Effect			
		Significant Beneficial Effect			
Receptors (property count)	DMRB impact magnitude - Short-term (Opening Year 2027)	DMRB impact magnitude - Long-term (Opening Year 2027 to Future Year 2042)	Factors informing significance conclusion	Mitigation Considerations	Conclusion of significance of environmental effect.
Stoke Road (A4019 to Bishops Cleeve) (5)	Moderate Increase Daytime - Moderate Increase at 3 properties Daytime - 1 increase to above SOAEL from DMOY Night-time - Minor Increases at 3 properties above SOAEL	Minor Increase Daytime – 1 increase to above SOAEL from DMOY Daytime – Minor Increases at 2 properties above SOAEL Night-time - Minor Increases at 5 properties above SOAEL	Properties predicted a Minor to Moderate change in noise. None of the increases are within a Noise Important Area, however some of the noise levels exceed the SOAEL.	Noise barriers have been considered, but would not possible due to access requirements. GCC are investigating measures to mitigate noise on Stoke Road, but not part of this Scheme.	Significant adverse effect
Stoke Orchard Village (58)	Minor Increase Daytime - 22 increases to above SOAEL from DMOY Daytime - Minor increase at 42 properties above SOAEL Night-time - 6 increases to above SOAEL from DMOY Night-time - Minor Increase at 45 properties above SOAEL	Minor Increase Daytime - 22 increases to above SOAEL from DMOY Daytime - Minor Increase at 44 properties above SOAEL Night-time - 9 increases to above SOAEL from DMOY Night-time - Minor Increase at 58 properties above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL.	Noise barriers have been considered, but would not possible due to access requirements. GCC are investigating measures to mitigate noise on Stoke Road, but not part of this Scheme.	
Sheldon Cottages (2)	Minor Decrease Daytime - Minor Decrease at 2 properties below SOAEL	Negligible Change	Properties predicted a Minor beneficial change in noise in short-term. The acoustic character of the noise will change, as new slip road screens the M5 and will become the dominant source of noise.	N/A	No significant effect
New House Farm, Moat Lane (1)	Moderate Increase Daytime - Moderate Increase at property	Minor Increase Daytime - Minor Increase at property, below SOAEL	Property predicted a Moderate change in noise in short term only, due to demolished properties that were screening noise from the A4019.	N/A	No significant effect
M5 Barn Farm (1), Informal Traveller site (at least 1	Minor to Moderate Decrease Daytime - Moderate Decrease at the Informal Travellers Site	Minor Decrease Daytime - Minor Decrease at all properties, above the SOAEL	Properties predicted a Moderate Decrease in the opening year.	N/A	Significant beneficial effect

Receptors (property count)	DMRB impact magnitude - Short-term (Opening Year 2027)	DMRB impact magnitude - Long-term (Opening Year 2027 to Future Year 2042)	Factors informing significance conclusion	Mitigation Considerations	Conclusion of significance of environmental effect.
	Daytime - Minor Decrease at Barn Farm above the SOAEL Night-time - Moderate Decrease at the Informal Travellers Site Night-time - Minor Decrease at Barn Farm above the SOAEL	Night-time - Minor Decrease at all properties, above the SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL.		
A4019 East of M5 J10 A4019 (39), Homecroft Drive (7), The Green (7), Cooks Lane (1), Sandpiper Drive (3), Coppice Gate (50), Yeend Close (9), Appleyard Close (2), River Leys (12) and Hayden Road (1)	Minor to Major Decrease Daytime - Major Decrease at 42 properties Daytime - Moderate Decrease at 56 properties Daytime - 2 decrease to below SOAEL from DMOY Daytime - Minor Decrease at 19 properties above the SOAEL Night-time - Major Decrease at 37 properties Night-time - Moderate Decrease at 51 properties Night-time – 2 decrease to below SOAEL from DMOY Night-time - Minor Decrease at 32 properties	Minor to Moderate Decrease Daytime - Major Decrease at 1 properties Daytime - Moderate Decrease at 42 properties Daytime - 9 decreases to below SOAEL from DMOY Daytime - Minor Decrease at 23 properties above the SOAEL Night-time - Moderate Decrease at 37 properties Night-time - 2 decreases to below SOAEL from DMOY Night-time - Minor Decrease at 23 properties	Properties predicted a Minor, Moderate or Major change in noise. Properties directly affected by Scheme design on A4019, including properties within NIA (3948, 3949 and 3950) Many of these properties also exceed the SOAEL.	N/A	Significant beneficial effect
A4019 West of J10 (11) The A4019 including Stanboro Cottage and the Gloucester Old Spot	Minor Increase Daytime - Minor Increase at 3 properties above SOAEL Night-time - Minor Increase at 6 properties above SOAEL	Minor Increase Daytime - Minor Increase at 11 properties above SOAEL Night-time - Minor Increase at 11 properties above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL.	Noise barriers have been considered, but would not possible due to access requirements and limited space. No mitigation measures have been proposed, effect is unavoidable.	Significant adverse effect
Boddington Road (6)	Negligible Change	Minor Increase Night-time - Minor Increase at 6 properties to above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL. Not considered significant as no change is observed in short term. Minor changes on this road have been observed in the Do Minimum 2042.	N/A	No significant effect

Receptors (property count)	DMRB impact magnitude - Short-term (Opening Year 2027)	DMRB impact magnitude - Long-term (Opening Year 2027 to Future Year 2042)	Factors informing significance conclusion	Mitigation Considerations	Conclusion of significance of environmental effect.
Withybridge Lane (7)	Minor to Major Decrease Daytime - Major Decrease at 3 properties Daytime - Moderate Decrease at 1 property Daytime - Minor Decrease at 3 properties above SOAEL Night-time - Moderate Decrease at 2 properties Night-time - Minor Decrease at 5 properties	Minor Decrease Daytime - Moderate Decrease at 4 properties Daytime - Minor Decrease at 2 properties above SOAEL Night-time - Minor Decrease at 7 properties	Properties predicted a Minor to Major change in noise. Only façade of properties adjacent to Withybridge Road exceeds the SOAEL, minor increase in noise from link road not significant. Significant benefit observed at 7 properties.	N/A	Significant beneficial effect
Hayden Lane (10) Old Gloucester Road (4)	Minor to Major Decrease Daytime - Major Decrease at 3 properties Daytime - Moderate Decrease at 7 properties Daytime - 1 decrease to below SOAEL from DMOY Daytime - Minor Decrease at 3 properties above the SOAEL Night-time - Moderate Decrease at 3 properties Night-time - Minor Decrease at 11 properties above SOAEL	Minor Decrease Daytime - 2 decreases to below SOAEL from DMOY Daytime - Minor Decrease at 5 properties above the SOAEL Night-time - 4 decreases to below SOAEL from DMOY Night-time - Minor Decrease at 11 properties	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL. Significant benefit observed at 11 properties	N/A	Significant beneficial effect
Gloucester Road (36)	Minor Increase Daytime – 30 increases to above SOAEL from DMOY Daytime - Minor Increase at 36 properties above SOAEL Night-time - Minor Increase at 32 properties above the SOAEL	Minor Increase Daytime - 30 increases to above SOAEL from DMOY Daytime - Minor Increase at 33 properties above SOAEL Night-time - Minor Increase at 31 properties above the SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL.	Noise barriers have been considered, but would not possible due to access requirements and limited space. Traffic speeds are already low so traffic calming measures would not be effective. No mitigation measures have been proposed, effect is unavoidable.	Significant adverse effect
Up Hatherley Way/The Reddings (59) Rowan Way (5), Swanscombe Place (2), Manor Park (10), Timperley Way (4), Rothleigh (5), Symphony Road (3), Egdon Crescent (3), Dumbleton Grove (1), Chargrove Lane (1), Rhapsody Court (1), Chasely Crescent (3), Thornhaugh Mews (2), Glyndthorpe Grove (3), Grovesfield Way (2), Holst Grove (2), Barrington	Minor Increase Daytime – 4 increases to above SOAEL from DMOY Daytime - Minor Increase at 4 properties above SOAEL	Minor Increase Daytime - 6 increases to above SOAEL from DMOY Daytime - Minor Increase at 6 properties above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL. Similar changes on these roads have been	Noise barriers have been considered, but would not possible due to access requirements and limited space. Traffic speeds are already low so traffic	No significant effect

Receptors (property count)	DMRB impact magnitude - Short-term (Opening Year 2027)	DMRB impact magnitude - Long-term (Opening Year 2027 to Future Year 2042)	Factors informing significance conclusion	Mitigation Considerations	Conclusion of significance of environmental effect.
Avenue (3), North Road West (1), Cold Pool Lane (2), The Reddings (6)	Night-time - Minor Increase at 2 properties above SOAEL	Night-time - 33 increases to above SOAEL from DMOY Night-time - Minor Increase at 53 properties above SOAEL	observed in the Do Minimum 2042.	calming measures would not be effective. No mitigation measures have been proposed, effect is unavoidable.	
Brooklyn Road/Arle Road (58)	Minor Increase Daytime - 1 increase to above SOAEL from DMOY Daytime - Minor Increase at 1 property above SOAEL Night-time - 56 increases to above SOAEL from DMOY Night-time - Minor Increase at 58 properties above SOAEL	Minor Increase Daytime - 1 increase to above SOAEL from DMOY Daytime - Minor Increase at 1 property above SOAEL Night-time - 56 increases to above SOAEL from DMOY Night-time - Minor Increase at 58 properties above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL.	Noise barriers have been considered, but would not be possible due to access requirements and limited space. Traffic speeds are already low so traffic calming measures would not be effective. No mitigation measures have been proposed, effect is unavoidable.	Significant adverse effect
Paynes Pitch (1)	Negligible Change	Minor Increase Daytime - Minor Increase at 1 property above SOAEL	One property predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL. Not considered significant as no change is observed in short term. Similar changes on this road have been observed in the Do Minimum 2042.	N/A	No significant effect
Old Road, Southam (2)	Negligible Change	Minor Increase Night-time - 1 increase to above SOAEL from DMOY Night-time - Minor Increase at 2 properties above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL. Not considered significant as no change is observed in short term. Similar changes in noise on this road have been observed in the Do Minimum 2042.	N/A	No significant effect
St James Terrace/ Ambrose Street/St Georges Place (19)	Minor to Moderate Decrease Daytime - Moderate Decrease at 17 properties Daytime - 2 decreases to below SOAEL from DMOY Night-time - Moderate Decrease at 6 properties	Minor Decrease Daytime – 1 decrease to below SOAEL from DMOY Daytime - Moderate Decrease at 1 property	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL	N/A	Significant beneficial effect

Receptors (property count)	DMRB impact magnitude - Short-term (Opening Year 2027)	DMRB impact magnitude - Long-term (Opening Year 2027 to Future Year 2042)	Factors informing significance conclusion	Mitigation Considerations	Conclusion of significance of environmental effect.
	Night-time - Minor Decrease at 8 properties above SOAEL	Night-time - Moderate Decrease at 2 properties Night-time - Minor Decrease at 9 properties above SOAEL			
Bamfurlong Lane including Gloucester Road & Staverton Park (14)	Minor to Moderate Decrease Daytime - Moderate Decrease at 12 properties Daytime - Minor Decrease at 2 properties above SOAEL Night-time - Minor Decrease at 2 properties above SOAEL	Minor Decrease Daytime - Minor Decrease at 1 property above SOAEL Night-time - Minor Decrease at 3 properties above SOAEL	Properties predicted a Minor to Moderate change in noise. Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL.	N/A	Significant beneficial effect
Princess Elizabeth Way (230) Including at junctions of Tanners Lane, Dormer Road, Wilson Drive, Edinburgh Place, Kingsmead Avenue, Orchard Way, Orchard Avenue, Anapa Mews, Marsland Road, Queens Place Dowty Road and Village Road	Minor to Moderate Decrease Daytime - 13 decreases to below SOAEL from DMOY Daytime - Minor Decrease at 230 properties above SOAEL Night-time - 2 decreases to below SOAEL from DMOY Night-time - Minor Decrease at 86 properties above SOAEL	Minor to Moderate Decrease Daytime - 6 decreases to below SOAEL from DMOY Daytime - Minor Decrease at 76 properties above SOAEL Night-time - 2 decreases to below SOAEL from DMOY Night-time - Minor Decrease at 40 properties above SOAEL	Properties predicted a Minor change in noise. Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL. Includes properties within NIA (3945, NIA 3946 and NIA 3894)	N/A	Significant beneficial effect
Old Cheltenham Road (2), Cheltenham Road East, Kilminster Court (1) and Vervain Close (5)	Negligible Change	Minor to Moderate Decrease Daytime - Minor Decrease at 2 properties above SOAEL Night-time – 17 decreases to below SOAEL from DMOY Night-time - Minor Decrease at 27 properties above SOAEL	Properties predicted a Minor change in noise. Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL. Not considered significant as no change is observed in short term. Similar changes in noise on this road have been observed in the Do Minimum 2041.	N/A	No significant effect

6.10. Cumulative effects

- 6.10.1. This section considers the cumulative effects of the Scheme and the Scheme interacting with other Reasonably Foreseeable Future Projects (RFFPs) within the noise and vibration topic.
- 6.10.2. The further consideration of cross-topic intra-Scheme and inter-project cumulative effects is reported in Chapter 15 - Cumulative Effects Assessment (application document TR010063 – APP 6.13).

Intra-Scheme in-combination cumulative effects assessment (single project impacts) within topic

- 6.10.3. The focus of the intra-Scheme CEA is understanding how receptors may experience a number of different types of impacts from the Scheme at the same time. Within the topic assessments, the noise and vibration assessment methodology inherently considers different sources of changes in noise source as well as vibration. Therefore, this assessment inherently considers combined effects from different sources. For example changes to the noise climate due to traffic as well as construction plant and equipment; and whether receptors experience both noise and vibration.
- 6.10.4. On the basis of the above, there are no additional intra-Scheme cumulative effects from the assessment of noise and vibration to report in this section.
- 6.10.5. An assessment of cross-topic intra-Scheme effects on all receptors is provided in Chapter 15 – Cumulative Effects Assessment (application document TR010063 – APP 6.13).

Inter-project cumulative effects assessment (different project impacts) within topic

- 6.10.6. To complete the cumulative effects assessment inter-project 'within topic' element, the Noise and Vibration assessment has been completed with reference to the list of RFFPs that has been developed for the Scheme. The list is based on a review of all developments known to the planning system using the methodology described in Chapter 4 – Environmental Assessment Methodology of the ES (application document TR010063 – APP 6.2).
- 6.10.7. The RFFP long-list was screened, identifying which RFFPs may result in inter-project cumulative effects in relation to the scope of the noise and vibration assessments. The screening criteria used were the scoping criteria set out in the National Highways guidance DMRB LA111 (paragraphs 3.1, 3.26 and 3.41), applied based on assumptions about the timing of the works and the location, size and type of development – RFFPs were scoped in if they met at least one of the criteria below.
- The construction noise generated by the Scheme or RFFP has the potential to adversely affect any noise sensitive receptors, including new properties within the RFFP.
 - The vibration from construction has the potential to adversely affect any vibration sensitive receptors, including new properties within the RFFP.
 - The Scheme or RFFP is likely to cause a change in the BNL of 1dB $L_{A10,18hr}$ in the do-minimum opening year (DMOY) compared to the do-something opening year (DSOY) including new properties within the RFFP.
 - The Scheme or RFFP is likely to cause a change in the BNL of 3dB $L_{A10,18hr}$ in the do-something future year (DSFY) compared to the DMOY, including new properties within the RFFP.
 - The Scheme or RFFP involve the construction of new road links within 600m of new or existing noise sensitive receptors.
- 6.10.8. A number of the RFFPs are embedded within the traffic modelling scenarios, as described in the Transport Assessment report (application document TR010063 - APP 7.5). The operational noise assessment of cumulative effects is conducted within the limitations of the traffic data available and forecasting of traffic growth rates. Therefore this inter-project aspect of the CEA is already considered intrinsically within the operational noise impact assessment for Traffic Scenario S and no further assessment is required.

- 6.10.9. A separate assessment of Traffic Scenario R, which accounts for traffic growth anticipated from the strategic development sites is included later in this section – this informs the conclusions drawn in respect of the inter-project cumulative effects of the Scheme in conjunction with the following RFFPs:
- North West Cheltenham Development Area, Off Tewkesbury Road, Uckington (Policy A4), associated with RFFPs 16/02000/OUT, 22/00759/FUL and 23/00354/OUT – with 22% of total Dwellings and 27% of the total floorspace for employment as operational in Traffic Scenario S (with 100% of the development operational in Traffic Scenario R)
 - Safeguarded land to the north-west of Cheltenham (Policy SD5) – with 9% of total Dwellings and 10% of the total floorspace for employment as operational in Traffic Scenario S (with 100% of the development operational in Traffic Scenario R)
 - West Cheltenham Development Area (Policy A7), associated with application 22/01817/OUT and 22/01107/OUT (the same application made to two separate authorities) – with 23% of total Dwellings and 25% of the total floorspace for employment as operational in Traffic Scenario S (with 100% of the development operational in Traffic Scenario R)
- 6.10.10. For those RFFPs that do not fall within the traffic modelling, the screening criteria listed above were applied to determine whether an RFFP is likely to be impacted by the M5 J10 Scheme as a result of introducing new sensitive receptors within the ARN described within this noise and vibration assessment, and also to identify if the RFFP is going to impact on the Scheme by introducing additional traffic during construction or operational phases. This was undertaken on a qualitative basis, using professional judgment.
- 6.10.11. For the CEA, the potential impact of the RFFP on the Scheme traffic was either included in Traffic Scenario S (and therefore already reflected in the main assessment), included in Traffic Scenario R (assessed later in this section) or judged qualitatively regarding the likelihood of exceeding the traffic scoping criteria. The outcomes of this exercise are provided in Table 6-28, which summarises those RFFPs for which there is potential for cumulative inter-project effects on noise and vibration, as well as confirming which traffic scenario has informed the judgments.

Table 6-29 - Assessment of interaction between Scheme and RFFPs scoped into inter-project cumulative assessment (within topic)

Location	Impact of Scheme on the noise and vibration on NSR within this development Reason	Impact of this development on Scheme assessment of noise and vibration on NSR Reason	Traffic scenario
Land At Manor Farm, Stoke Road, Stoke Orchard, Cheltenham, Gloucestershire, GL52 7RY (22/01377/FUL)	The noise assessment of the Scheme has predicted a potential significant adverse effect on Stoke Road. GCC is investigating measures to mitigate noise on Stoke Road but not as part of this Scheme. This development is outside the construction noise and vibration study areas.	Development is too small to impact on the Scheme.	Qualitative
Manor Farm Yard, Stoke Road, Stoke Orchard, Cheltenham, Gloucestershire, GL52 7RY (20/00213/FUL)	The noise assessment of the Scheme has predicted a potential significant adverse effect on Stoke Road. GCC is investigating measures to mitigate noise on Stoke Road but not as part of this Scheme. This development is outside the construction noise and vibration study areas.	Development is too small to impact on the Scheme.	Qualitative
Gloucester Old Spot Public House, A4019 Tewkesbury Road, Elmstone Hardwicke, GL51 9SY (22/00549/FUL)	The noise assessment of the Scheme has predicted a potential minor significant adverse effect on Tewkesbury Road, which would affect NSR at this location.	Development is too small to impact on the Scheme.	Qualitative
Knightsbridge Nurseries, A4019 Tewkesbury Road, GL51 9SY (23/00328/OUT)	The noise assessment of the Scheme has predicted a potential minor significant adverse effect on Tewkesbury Road, which would affect NSR at this location.	Development is too small to impact on the Scheme.	Qualitative
The Barn, Hayden Farm, Hayden Lane, Boddington, Cheltenham, Gloucestershire, GL51 0SR (19/00937/PDAD)	Operational noise is predicted to improve on both Hayden Lane and the B4634 with the Scheme. Due to the existing traffic flow on B4634, it is unlikely that any additional construction traffic would have an effect on this property.	Development is too small to impact on the Scheme.	Qualitative

Location	Impact of Scheme on the noise and vibration on NSR within this development Reason	Impact of this development on Scheme assessment of noise and vibration on NSR Reason	Traffic scenario
	This development is at least 100m from the works and unlikely to be affected by significant adverse noise and vibration effects.		
A & B Buildings At Pilgrove Farm, Pilgrove Farm, B4634Boddington, Cheltenham, Gloucestershire, GL51 0SW (19/00907/PDAD)	Operational noise is predicted to improve on both Hayden Lane and the B4634 with the Scheme. Due to the existing traffic flow on the B4634, it is unlikely that any additional construction traffic would have an effect on this property. This development is outside the construction noise and vibration study areas.	Development is too small to impact on the Scheme.	Qualitative
Pilgrove Cottage, Old Gloucester Road, GL51 0SW (22/02172/FUL)	Operational noise is predicted to improve on both Hayden Lane and the B4634 with the Scheme. Due to the existing traffic flow on the B4634, it is unlikely that any additional construction traffic would have an effect on this property. This development is outside the construction noise and vibration study areas.	Development is too small to impact on the Scheme.	Qualitative
The Old School House, Stoke Road, Stoke Orchard, Cheltenham, Gloucestershire, GL52 7RY (20/00003/FUL)	The noise assessment of the Scheme has predicted a potential significant adverse effect on Stoke Road. GCC is investigating measures to mitigate noise on Stoke Road but not as part of this Scheme. This development is outside the construction noise and vibration study areas.	Development is too small to impact on the Scheme.	Qualitative
Warners Of Cheltenham, Blaisdon Way, Cheltenham, Gloucestershire, GL51 0WH (20/02132/FUL)	Operational noise is predicted to improve on both Hayden Road and the B4634 with the Scheme. Due to the existing traffic flow on the B4634, it is unlikely that any additional construction traffic would have an effect on this property.	This development could generate new traffic, but 12 units is unlikely to cause a significant increase in noise, when compared with existing traffic flow.	Qualitative

Location	Impact of Scheme on the noise and vibration on NSR within this development Reason	Impact of this development on Scheme assessment of noise and vibration on NSR Reason	Traffic scenario
Lansdown Industrial Estate, Gloucester Road, Cheltenham (21/02832/OUT)	The development is outside the Study Area of the Scheme, and so unlikely to be affected by the Scheme.	The additional 50 homes that would be in use by the opening year (out of 215) would increase the number of trips on the traffic network, but the traffic is unlikely to exceed the daily 3500 construction vehicle threshold for a significant effect.	Qualitative
Gallagher Retail Park, A4019, Uckington, Cheltenham, Gloucestershire, GL51 9RR (17/00827/FUL, 17/01459/FUL & 21/02120/FUL)	No impact as a result of the nature of the development.	Additional traffic from developments taken into account in traffic model.	Scenario S
22/00164/PIP land known as Evergreen Spiritual Pathways The Green Uckington (3 homes)	<p>The CEA assumes that the RFFP will be under construction in the same timeframe as Scheme construction and fully built out before Scheme opening year. On this basis, the construction traffic for this development could interact with the construction traffic and traffic management for the M5 J10 Scheme, but total traffic is unlikely to exceed the daily 3500 construction vehicle threshold for a significant effect.</p> <p>The increase in noise with the Scheme on The Green is just over 1dB, but only when adjacent to the road. The developers should be taking into account the noise from the local roads when designing the masterplan for the development.</p>	There could be an impact if the construction traffic for this development interacts with the construction traffic and traffic management for the M5 J10 Scheme, but total traffic is unlikely to exceed the daily 3500 construction vehicle threshold for a significant effect.	Qualitative
Pigeon House Farm, The Green, Uckington, GL51 9SR (22/01272/FUL)	The CEA assumes that the RFFP will be under construction in the same timeframe as Scheme construction and fully built out before Scheme opening year. On this basis, the construction traffic	Development is too small to impact on the Scheme.	Qualitative

Location	Impact of Scheme on the noise and vibration on NSR within this development Reason	Impact of this development on Scheme assessment of noise and vibration on NSR Reason	Traffic scenario
	<p>for this development could interact with the construction traffic and traffic management for the M5 J10 Scheme, but total traffic is unlikely to exceed the daily 3500 construction vehicle threshold for a significant effect.</p> <p>The increase in noise with the Scheme on The Green is just over 1dB, but only when adjacent to the road. The developers should be taking into account the noise from the local roads when designing the masterplan for the development.</p>		
<p>Uckington Farm, The Green, Uckington, GL51 9SR (22/01163/FUL)</p>	<p>The CEA assumes that the RFFP will be under construction in the same timeframe as Scheme construction and fully built out before Scheme opening year. On this basis, the construction traffic for this development could interact with the construction traffic and traffic management for the M5 J10 Scheme, but total traffic is unlikely to exceed the daily 3500 construction vehicle threshold for a significant effect.</p> <p>The development could lead to properties that front the Green being surrounded by construction and construction noise on all sides. There is a need for coordination between the developers, as referenced in the REAC - Register of Environmental Actions and Commitments (REAC) (application document TR010063 – APP 7.4) - CEA 3.</p> <p>The increase in noise with the Scheme on The Green is just over 1dB, but only when adjacent to the road. The developers should be taking into account the noise from the local roads when designing the masterplan for the development.</p>	<p>The CEA assumes that the RFFP will be under construction in the same timeframe as Scheme construction and fully built out before Scheme opening year. On this basis, the construction traffic for this development could interact with the construction traffic and traffic management for the M5 J10 Scheme, but total traffic is unlikely to exceed the daily 3500 construction vehicle threshold for a significant effect.</p> <p>There is a need for coordination between the developers, as referenced in the REAC - Register of Environmental Actions and Commitments (REAC) (application document TR010063 – APP 7.4) - CEA 3.</p>	<p>Qualitative</p>

Location	Impact of Scheme on the noise and vibration on NSR within this development Reason	Impact of this development on Scheme assessment of noise and vibration on NSR Reason	Traffic scenario
Home Farm, Quat Goose Lane, Cheltenham, GL51 9RP (23/00354/OUT)	The development is outside the Study Area of the Scheme, and so unlikely to be affected by the Scheme.	The additional 180 homes would increase the number of trips on the traffic network, but the traffic is unlikely to exceed the daily 3500 construction vehicle threshold for a significant effect.	Qualitative
22/00474/FUL - Douglas Equipment Village - 71 residential properties	<p>The CEA assumes that the RFFP will be under construction in the same timeframe as Scheme construction and up to 25% built out (18 dwellings) before Scheme opening year. On this basis, the construction traffic for this development could interact with the construction traffic and traffic management for the M5 J10 Scheme, but total traffic is unlikely to exceed the daily 3500 construction vehicle threshold for a significant effect.</p> <p>The change in noise with the Scheme at the location of the development is negligible. The developers should be taking into account the noise from the local roads when designing the masterplan for the development.</p>	There could be an impact if the construction traffic for this development interacts with the construction traffic and traffic management for the M5 J10 Scheme, but total traffic is unlikely to exceed the daily 3500 construction vehicle threshold for a significant effect.	Qualitative
<p>Phase 1 Land at Old Gloucester Road. (21/00872/REM)</p> <p>Relates to South West portion of land allocated as Site HD8 in the Cheltenham Local Plan - B4634 Development land allocated for 175 homes (11.3ha)</p>	<p>The CEA assumes that the RFFP will be under construction in the same timeframe as Scheme construction and up to 50% built out (43 dwellings) before Scheme opening year. On this basis, the construction traffic for this development could interact with the construction traffic and traffic management for the M5 J10 Scheme, but total traffic is unlikely to exceed the daily 3500 construction vehicle threshold for a significant effect.</p> <p>The change in noise with the Scheme at the location of the development is negligible. The developers</p>	Additional traffic from developments taken into account in traffic model.	Scenario S

Location	Impact of Scheme on the noise and vibration on NSR within this development Reason	Impact of this development on Scheme assessment of noise and vibration on NSR Reason	Traffic scenario
	should be taking into account the noise from the local roads when designing the masterplan for the development.		
North-west Cheltenham Development Area (Policy A4) Elms Park, Off the A4019, Uckington (16/02000/OUT)	The policy allocation indicates that the development is dependent upon transport infrastructure improvements. These are to be delivered by the Scheme. The CEA assumptions are that construction overlap may be anticipated in terms of enabling works and some infrastructure works, but that no residential receptors will be present until the Scheme is operational. The construction traffic for this development could interact with the construction traffic and traffic management for the M5 J10 Scheme, but total traffic is unlikely to exceed the daily 3500 construction vehicle threshold for a significant effect. The developers should be taking into account the noise from the local roads when designing the masterplan for the development.	There could be an impact at existing properties as a result of timing of construction, although the construction phase overlap is expected to be minor. The construction traffic for this development could interact with the construction traffic and traffic management for the M5 J10 Scheme, but total traffic is unlikely to exceed the daily 3500 construction vehicle threshold for a significant effect. More information about the cumulative construction and operational noise assessment is provided in this section using traffic scenario R, including a comparison without this development, traffic scenario S.	Scenario R
Swindon Farm, A4019, Cheltenham, Gloucestershire (20/00759/FUL) Part of North-west Cheltenham Development Area (Policy A4)	There could be an impact at existing properties as a result of timing of construction. The CEA assumptions are that 25% of homes may be occupied at the commencement of Scheme construction, rising to 75% of homes once the Scheme is operational. The construction traffic for this development could interact with the construction traffic and traffic management for the M5 J10 Scheme, but total traffic is unlikely to exceed the daily 3500 construction vehicle threshold for a significant effect. It is assumed that all prospective residents will be informed about the nature and planned duration of the works to minimise the	There could be an impact at existing properties as a result of timing of construction, although the construction phase overlap is expected to be minor. The construction traffic for this development could interact with the construction traffic and traffic management for the M5 J10 Scheme, but total traffic is unlikely to exceed the daily 3500 construction vehicle threshold for a significant effect. More information about the cumulative construction and operational noise assessment is provided in this section using traffic scenario R,	Scenario R

Location	Impact of Scheme on the noise and vibration on NSR within this development Reason	Impact of this development on Scheme assessment of noise and vibration on NSR Reason	Traffic scenario
	<p>potential impact of the works from both the RFFP and the Scheme.</p> <p>The developers should be taking into account the noise from the local roads when designing the masterplan for the development.</p>	<p>including a comparison without this development, traffic scenario S.</p>	
<p>Safeguarded land to the north-west of Cheltenham (Policy SD5)</p>	<p>The policy indicates that the development is dependent upon transport infrastructure improvements. These are to be delivered by the Scheme. The CEA assumptions are that construction overlap may be anticipated in terms of enabling works and some infrastructure works, but that no residential receptors will be present until the Scheme is operational. The construction traffic for this development could interact with the construction traffic and traffic management for the M5 J10 Scheme, but total traffic is unlikely to exceed the daily 3500 construction vehicle threshold for a significant effect.</p> <p>The developers should be taking into account the noise from the local roads when designing the masterplan for the development.</p>	<p>There could be an impact at existing properties as a result of timing of construction, although the construction phase overlap is expected to be minor. The construction traffic for this development could interact with the construction traffic and traffic management for the M5 J10 Scheme, but total traffic is unlikely to exceed the daily 3500 construction vehicle threshold for a significant effect.</p> <p>More information about the cumulative construction and operational noise assessment is provided in this section using traffic scenario R, including a comparison without this development, traffic scenario S.</p>	<p>Scenario R</p>
<p>West Cheltenham Development Area (Policy A)</p> <p>Planning application (22/01817/OUT 22/01107/OUT)</p>	<p>The policy allocation indicates that the development is partially dependent upon transport infrastructure improvements. These are to be delivered by the Scheme. The CEA assumptions are that construction overlap may be anticipated in terms of enabling works and some infrastructure works, but that no residential receptors will be present until the Scheme is operational. The construction traffic for this development could interact with the construction traffic and traffic management for the M5 J10 Scheme, but total traffic is unlikely to exceed the</p>	<p>There could be an impact at existing properties as a result of timing of construction, although the construction phase overlap is expected to be minor. The construction traffic for this development could interact with the construction traffic and traffic management for the M5 J10 Scheme, but total traffic is unlikely to exceed the daily 3500 construction vehicle threshold for a significant effect.</p>	<p>Scenario R</p>

Location	Impact of Scheme on the noise and vibration on NSR within this development Reason	Impact of this development on Scheme assessment of noise and vibration on NSR Reason	Traffic scenario
	daily 3500 construction vehicle threshold for a significant effect. The developers should be taking into account the noise from the local roads when designing the masterplan for the development.	More information about the cumulative construction and operational noise assessment is provided in this section using traffic scenario R, including a comparison without this development, traffic scenario S.	

- 6.10.12. Based on the information in Table 6-28, it is unlikely that many of the RFFPs have the potential to lead to a significant adverse construction noise, construction vibration or operational noise effects. However, the strategic development sites that are within the study area of the Scheme are large developments that are noted in their respective policy allocations as being dependent on transport infrastructure improvements. These improvements are to be delivered by the Scheme and so these strategic development sites have been assessed in more detail than other developments. These developments are:
- The safeguarded land to the north-west of Cheltenham (Policy SD5).
 - The North West Cheltenham Development Area (Policy A4) (including planning applications made in respect of Elms Park 16/02000/OUT, Swindon Farm 20/00759/FUL and Home Farm (23/00354/OUT).
 - The West Cheltenham Development Area (Policy A7) (and associated planning application 22/01817/OUT and 22/01107/OUT (the same application made to two local authorities)).

Construction of the strategic development sites

- 6.10.13. For the purposes of the CEA, a set of assumptions has been made regarding the likely progression of the strategic development site RFFPs relative to the Scheme. They are provided in Chapter 15 - Cumulative Effects Assessment (application document TR010063 – APP 6.13), and inform the assessment that is reported here.

Scheme affecting RFFPs as receptors

- 6.10.14. For all strategic development sites, the developments are noted in policy as being dependent upon transport infrastructure improvements in order to realise their full capacity. These transport improvements are proposed to be delivered by the Scheme. The CEA assumes construction overlap in terms of enabling works and some infrastructure works on all strategic development sites; and the presence of some residential receptors within the Swindon Farm area (20/00759/FUL) at the commencement of Scheme construction. Therefore the potential for cumulative construction impact of the Scheme on the prospective residents of the strategic development site RFFP developments themselves is limited.
- 6.10.15. For the Swindon Farm development (20/00759/FUL), it has been assumed that 25% of homes may be occupied at the start of Scheme construction, rising to up to 75% of homes once the Scheme is operational and there is potential for the Scheme construction works to affect prospective residents. However, it is considered that any prospective residents would be well informed about the nature and planned duration of construction for both the Scheme and the development before they move in. On this basis, their sensitivity has been considered to be lower for the purposes of the CEA. **No significant adverse residual cumulative inter-project effect is predicted** for this type of interaction relating to construction noise.

RFFP and Scheme combining to affect same receptors

- 6.10.16. In all cases there could be an additive cumulative inter-project noise impact of the strategic development sites and Scheme acting together. This could be experienced at existing properties with the cumulative impact having the potential to both extend the time period and increase the noise levels for these properties for the duration of assumed construction phase overlap. The construction traffic for these developments could interact with the construction traffic and traffic management for the M5 J10 Scheme, but the total traffic is unlikely to exceed the daily 3500 construction vehicle threshold for a significant effect.
- 6.10.17. There is essential mitigation identified through the CEA process that seeks to ensure effective co-ordination of all strategic highways works on the GCC network through a centralised process. This is described in the Register of Environmental Actions and Commitments (REAC) (application document TR010063 – APP 7.4) under reference CEA1.

- 6.10.18. **No significant adverse residual cumulative inter-project effect is predicted** as a result of the cumulative construction noise, due to the Scheme combining with the strategic development sites.

Operation of the strategic development sites – impacts on prospective residents of new properties

- 6.10.19. An additional traffic model (Scenario R) has been assessed for 2042, which includes the strategic development sites (as described in 6.10.12), in order to determine the cumulative impact of the relevant RFFPs plus the Scheme on the study area in the future year. The strategic sites themselves have not been modelled as individual receptors, as their progression is dependent on availability of improved transport infrastructure (which will be delivered by the Scheme), so they do not exist in a Do Minimum Scenario.
- 6.10.20. Each of the planning applications includes masterplans for the development of the strategic sites. However, since these have not yet all secured planning permission, there remains uncertainty about the specific way in which the developments will be brought forward. As a consequence of this uncertainty, the benefit of screening from the development buildings cannot be determined and has not been factored into the analysis. Although it is not possible to determine noise levels for the whole site, an indication of the absolute noise levels at the edge of each of the strategic sites has been determined using the LOAEL and SOAEL criteria versus distance.
- 6.10.21. Within the safeguarded land to the north-west of Cheltenham, the absolute daytime noise levels in the future year are predicted to be greater than 68dB $L_{A10,18hr}$ (SOAEL) and 55dB $L_{A10,18hr}$ (LOAEL) when around 70m and 600m from the M5 respectively, and when 40m and 300m from the A4019 respectively. Similarly, within the North West Cheltenham Development Area, the noise levels exceed the SOAEL around 20m, and the LOAEL around 200m, from the A4019. When compared with the DMOY, changes to noise levels are moderate to around 30m from the A4019, and minor from 30m-60m from the A4019. Noise mitigation, in the form of bunds or noise barriers, have not been incorporated along the north of the A4019 to improve noise within the development areas as part of the Scheme. It is the responsibility of the developer to consider noise when designing the development.
- 6.10.22. Within the West Cheltenham Development Area, noise levels exceed the SOAEL when 20m and LOAEL when 200m to 300m from B4634 Old Gloucester Road, Pheasant Lane and Fiddlers Green Lane. When compared with the DMOY, changes in noise levels are negligible. Noise mitigation, in the form of bunds or noise barriers, have not been incorporated to improve noise within this development area as part of the Scheme. It is the responsibility of the developer to consider noise when designing the development.
- 6.10.23. Typically, the lowest noise levels predicted within the safeguarded land to the north-west of Cheltenham and West Cheltenham Development Area are 50 to 55dB $L_{A10,18hr}$ as constrained by roads. The noise levels within the North West Cheltenham Development Area were predicted to be as low as 45dB $L_{A10,18hr}$.
- 6.10.24. It is expected that the developers will be taking into account the noise from the local roads when designing the masterplan and noise mitigation for the development. Figure 6-9 and Figure 6-14 of Appendix 6.1 (application document TR010063 – APP 6.15) provide the Do Something cumulative (Traffic Scenario R) future year noise contour map, for daytime and night-time.
- 6.10.25. There is the potential for the residents of Swindon Farm (20/00759/FUL) to experience noise due to the operation of the Scheme, but the prospective residents should be informed about the nature of the works when choosing to take occupation of properties within the development. It is not expected that the operational noise from the Scheme would lead to a significant effect within the development.
- 6.10.26. The noise levels at the edges of the strategic development sites are predicted to exceed the SOAEL threshold value, and the developer must consider noise when determining the orientation of the rooms within the dwellings, the location of amenity space and the use of the non-residential buildings, and may need to incorporate mitigation to increase the area of the site that can be used for housing. It is the responsibility of the developer to include noise mitigation at the site as necessary, as without an understanding of the vision of the

development, the Scheme cannot be expected to necessarily provide the optimum mitigation strategy for the site.

Operation of the strategic development sites – impact of RFFPs and Scheme in combination on existing properties

6.10.27. To appraise the cumulative future year noise impacts of the Scheme a comparison has been made between the noise model results of the cumulative Do Something 2042 scenario vs the Do Minimum 2027 scenario (Traffic Scenario R). Where all assumptions from the Traffic Scenario S assessment, such as the inclusion of embedded mitigation were identical for Traffic Scenario R. The magnitude of these future year (long-term) noise impacts are summarised in Table 6-30 below.

Table 6-30 - Long-term daytime traffic noise impacts – cumulative (Traffic Scenario R)

Increase/decrease in noise	Change in noise level dB L _{A10,18h} /L _{night}	Magnitude of Impact	Daytime - Number of residential properties	Daytime - Number of other sensitive receptors	Night-time Number of residential properties	Night-time Number of other sensitive receptors
Increase	3 - 4.9	Minor	121	3	58	0
Increase	5 - 9.9	Moderate	23	3	3	0
Increase	>=10	Major	0	0	0	0
Negligible	-2.9 - 2.9	Negligible	13589	563	13681	40
Decrease	3 - 4.9	Minor	13	3	13	0
Decrease	5 - 9.9	Moderate	38	1	29	0
Decrease	>=10	Major	0	0	0	0

6.10.28. Table 6-30 demonstrates that, within the study area, the majority of receptors are predicted to experience a negligible change due to the Scheme over the long-term.

6.10.29. There are 13 residential properties that are predicted to experience a minor beneficial impact due to the Scheme over the long-term, located alongside the A4019, the M5 and Withybridge Lane, due to the new alignment and noise barriers. At night there are 14 properties, all located on the A4019 and M5.

6.10.30. There are 38 residential properties predicted to experience moderate beneficial impacts upon opening of the Scheme, and these are located along the A4019, all as a result of the changes to the Scheme and noise barriers. At night this is 29 properties, also along the A4019, with an no properties with a major noise benefit.

6.10.31. There are three non-residential sensitive receptors predicted to experience a minor beneficial impact due to the Scheme in the daytime and at night, and one with a moderate benefit during the day. These include Aldi as minor and L A Fitness as moderate, both on the A4019, plus two non-residential properties within St James Square. The affected non-residential properties do not have specific sensitivities to noise and do not require a separate assessment.

6.10.32. Adverse impacts are predicted in the long-term with the Cumulative Scheme due to changes in traffic flow and alignment, when compared with the Do Minimum in the opening year.

6.10.33. There are 121 residential properties that are predicted to experience a minor adverse change in noise due to the Scheme upon opening. These include Stoke Road, Bishops Cleeve, Boddington Road, The Green/ Road to Elmstone Hardwicke, New House Farm, Moat Lane, Telstar Way and Monks Lane. There are 58 properties predicted minor adverse changes at night, in the same areas.

6.10.34. There are 23 residential properties which are predicted to experience a moderate adverse change in noise. These are all located at New House Farm on Moat Lane, on the Boddington Road/Church Lane and on The Green/ Road to Elmstone Hardwicke. New

House Farm just meets the criteria for a moderate increase as a result of reduced screening between the property and the A4019, and additional traffic on the A4019 with Traffic Scenario R. In the remaining cases these roads are not currently used by many vehicles (around 1000 AAWT 18hr or less), but in the cumulative scenario the additional vehicles lead to a moderate adverse change.

- 6.10.35. At night the number of residential properties with a moderate adverse change in noise is reduced to three, but also on the Green/ Road to Elmstone Hardwicke. There are no predicted major impacts due to the cumulative Scheme daytime or night-time.
- 6.10.36. There are 3 minor increases predicted at non-residential sensitive receptors by the future year due to the Scheme in the daytime and one in the night-time, located at The Cross in Boddington, Gotherington Old Chapel and Post Office. In addition, there are three properties with a moderate increase in the daytime, located at the Orchard at The Green, Village Hall Uckington and Elmstone Hardwicke, and the Church of St Mary Magdalene.
- 6.10.37. The principal difference between the Scheme with and without the strategic development sites is the minor to moderate increase in noise along Telstar Way, Boddington Lane and The Green. The increase in noise on these three roads is as a result of the new development traffic, and not the Scheme, so is not considered to be significant for the Scheme but is a Significant Cumulative effect (additive).
- 6.10.38. Figure 6-9 and Figure 6-14 of Appendix 6.1 (application document TR010063 – APP 6.15) provide the Do Something cumulative (Traffic Scenario R) future year noise contour map, for daytime and night-time, and also demonstrate the locations of LOAEL and SOAEL exceedances.

Assessment of significance

- 6.10.39. For comparison with the DSOY and Scenario S, the initial assessment of the daytime and night-time long-term cumulative operational noise significance in EIA terms at NSRs is summarised in Table 6-31.

Table 6-31 - Summary of the initial assessment of long-term cumulative operational noise significance cumulative (Scenario R) 2043

Initial assessment of operational noise significance	Number of receptors where operational noise is significant - Adverse	Number of receptors where operational noise is significant - Beneficial
Significant - Day	23	3
Not Significant - Day	6601	6746
Significant - Night	38	29
Not Significant - Night	7019	6881

- 6.10.40. Table 6-31 demonstrates that without taking into account all of the contextual factors, there would be 24 daytime significant adverse effects due to the Scheme. However, the DMRB LA 111 states that where the long-term impact is predicted to be less than the short-term it can be appropriate to conclude that a moderate or major change in the short-term is not significant, and vice versa. The only property with a significant adverse effect in both the short term and long term is New House Farm, on Moat Lane.
- 6.10.41. In addition to the contextual situations provided for Scenario S, Scenario R also includes the impact of the strategic development sites on the flow and volume of traffic. As an example, this includes the change in traffic on Telstar Way due to the West Cheltenham Development Area. Where Traffic Scenario R introduces a new Significant Adverse Effect that did not exist for Traffic Scenario S, this has been indicated as a 'Cumulative Significant Adverse Effect'.
- 6.10.42. As with Traffic Scenario S, potential qualification for noise insulation has not been used to reduce the significance of impacts and the properties that may be eligible for Noise Insulation will not change with Scenario R.

6.10.43. The assessment of the significance of environmental effects from the Traffic Scenario R, with Scheme and strategic development sites, is summarised in Table 6-33, where a key for the tables is at the end. The residential properties which meet the criteria for significance are show in Figure 6.17 of Appendix 6.1 (application document TR010063 - APP 6.15).

Comparison of Traffic Scenarios

6.10.44. The noise assessment has provided the predicted change in noise and the absolute noise levels at each of the receptors to determine the potential for significant beneficial and adverse noise effects for both Scenarios R and S versus DMOY.

6.10.45. This assessment does not take into account site context or whether the changes are as a result of the development, the Scheme or traffic growth, but gives an indication of the extent of the impact from the development in the daytime and night-time. This information is all provided in Table 6-31.

Table 6-32 - Comparison of significant effects on residential properties – Scenario S vs Scenario R

Change in noise	Short-term Day	Scenario S Long-term Day	Scenario R Long-term Day	Short-term Night	Scenario S Long-term Night	Scenario R Long-term Night
Moderate and Major Decrease	144	46	38	98	37	29
1dB+ decrease above SOAEL	267	113	61	175	163	132
1dB+ increase above SOAEL	85	99	179	169	238	433
Moderate and Major Increase	4	0	23	0	0	3

6.10.46. Table 6-31 demonstrates that during the daytime period, there are a number of properties with potential significant adverse effects that are common in both scenarios like Stoke Road and Brooklyn Road, where properties are predicted a minor increase (or greater) where noise levels already exceed the SOAEL.

6.10.47. However, there are additional properties which are predicted to experience a moderate adverse change in noise with Scenario R, located on Boddington Road/Church Lane, The Green/ Road to Elmstone Hardwicke and Moat Lane.

6.10.48. The number of potential significant beneficial effects in the daytime are less with Scenario R in the daytime and night-time. Beneficial effects are located mainly along the A4019 east of the M5 Junction 10. The benefits of the Scheme are less pronounced with Scenario R during the day, with more traffic on the network. However, Scenario R introduces a significant beneficial effect at night on Hesters Way Road.

6.10.49. The night-time operational noise assessment of Scenario R indicates that there are almost double the number of properties with a potential significant adverse effect when compared with Scenario S, including 3 additional moderate or major adverse effects. Additional properties with a significant adverse effect, due to a minor increase above the SOAEL, on Monk Lane, in Tredington, in Bishops Cleeve and on Down Hatherley Lane.

6.10.50. Both traffic scenarios include potential significant adverse effects on the A4019 West of the M5 Junction 10, Up Hatherley Way, Brooklyn Road and Gloucester Road.

6.10.51. With common benefits on the A4019 East of the M5, St James Square, Withybridge Lane, Hayden Lane and Bamfurlong Lane. However, the benefits are less pronounced, such as on Princess Elizabeth Way, where the only remaining benefits are on Marsland Road with Scenario R.

- 6.10.52. The assessment of green spaces is the same for Scenario R and Scenario S, with no significant adverse effects predicted. However, with the developments in place, some of the footpaths through the development areas will no longer be quiet green spaces.

Summary of Cumulative Effects

- 6.10.53. Intra-Scheme cumulative effects within topic

- The noise and vibration assessment is inherently cumulative within topic. There are no intra-scheme in-combination residual effects within topic predicted as a result of the Scheme.

- 6.10.54. Inter-project cumulative effects within topic

- There are no significant residual inter-project additive cumulative effects predicted due to the non-strategic developments.
- There are no significant residual inter-project additive construction noise or vibration cumulative effects predicted due to the strategic developments.
- There are inter-project additive operational noise cumulative effects predicted due to the strategic developments in combination with the Scheme – this is principally due to predicted changes to traffic flows. The traffic modelling that underpins this assessment is Traffic Scenario R, which accounts for the Scheme plus the following three strategic developments: the safeguarded land to the north-west of Cheltenham, the North West Cheltenham Development Area and the West Cheltenham Development Area. It is important to note that the modelling does not provide a level of granularity that allows traffic to be assigned to the RFFPs separately, therefore each incidence of an in-combination effect is attributed to all three of the strategic sites, which represents a precautionary approach. It is also important to recognise that these effects emerge only when the RFFPs are factored in. The impacts equate to changes of either 5dB or more (moderate to major), or 1dB or more (minor) above the SOAEL threshold, affecting sensitive receptors along the following roads (which are unaffected by the Scheme in isolation or observed in the Do Minimum 2042):
 - Boddington Road/Church Lane - 7 Properties with a Moderate Increase.
 - The Green/ Road to Elmstone Hardwicke - 15 Properties with a Moderate Increase.
 - Telstar Way/Fiddlers Green Lane - 32 properties with a Minor Increase above the SOAEL.
 - Road from Stoke Orchard to Ashchurch (through Tredington and Fiddington) - 37 properties with a Minor Increase above the SOAEL.
 - Bishops Cleeve (Cheltenham Road, Voxwell Lane, Gotherington Lane and Evesham Road) - 25 properties with a Minor Increase above the SOAEL.
 - Cirencester Road and Stillchester Road - 4 properties with a Minor Increase above the SOAEL.
 - Down Hatherley Road - 7 properties with a Minor Increase above the SOAEL.
 - Innsworth Lane - 20 properties with a Minor Increase above the SOAEL.
 - Hesters Way Road – 34 properties with a Minor Decrease above the SOAEL
- Changes of greater than 1dB are considered to be significant on the basis of the DMRB methodology. However, the determining factor in these instances are the RFFPs as none of these locations feature within the assessment of the Scheme in isolation. Mitigation opportunities for noise at these locations are considered limited. This is due principally to access requirements and further information is provided in Table 6-33 below.
- In essence, these effects are considered unavoidable in seeking to realise the wider benefits of the Scheme. The REAC (application document TR010063 – APP 7.4) includes a commitment to a process of monitoring Scheme impacts across a range of sustainability criteria and this offers a mechanism for future requirements to be reviewed further if appropriate.

- 6.10.55. This table provides an analysis that builds on the assessment of noise and vibration impacts from Traffic Scenario S. It provides the assessment of the inter-project effects of the Scheme in combination with the three strategic development sites: the safeguarded land to the north-west of Cheltenham, the North West Cheltenham Development Area and the West Cheltenham Development Area, using traffic modelling inputs that account for the anticipated access routes and trip generation.

Table 6-33 - Assessment of significant cumulative environmental effects – Traffic Scenario R

Legend – Significant Effect					
		Cumulative Significant Adverse Effect			
		Significant Adverse Effect			
		Significant Beneficial Effect			
		Cumulative Significant Beneficial Effect			
Receptors (property count)	DMRB impact magnitude - Short-term (Opening Year 2027)	DMRB impact magnitude - Long-term (Opening Year 2027 to Future Year 2042)	Factors informing significance conclusion	Mitigation Considerations	Conclusion of significance of environmental effect.
Stoke Road (A4019 to Bishops Cleeve) (5)	Moderate Increase Daytime - Moderate Increase at 3 properties Daytime - 1 increase to above SOAEL from DMOY Night-time - 3 Minor Increases above SOAEL	Minor Increase Daytime – 1 increase to above SOAEL from DMOY Daytime – 2 Minor Increases above SOAEL Night -time – 2 increases to above SOAEL from DMOY Night-time - 5 Minor Increases above SOAEL	Properties predicted a Moderate change in noise. None of the increases are within a Noise Important Area, however some of the noise levels exceed the SOAEL.	Noise barriers have been considered, but would not possible due to access requirements. GCC are investigating measures to mitigate noise on Stoke Road, but not part of this Scheme.	Significant adverse effect
Stoke Orchard Village (63)	Minor Increase Daytime - 22 increases to above SOAEL from DMOY Daytime - Minor Increase at 42 properties above SOAEL Night-time - 6 increases to above SOAEL from DMOY Night-time - Minor Increase at 45 properties above SOAEL	Minor Increase Daytime - 23 increases to above SOAEL from DMOY Daytime - Minor Increase at 43 properties above SOAEL Night-time - 41 increases to above SOAEL from DMOY Night-time - Minor Increase at 63 properties above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL.	Noise barriers have been considered, but would not possible due to access requirements. GCC are investigating measures to mitigate noise on Stoke Road, but not part of this Scheme.	Significant adverse effect
Fiddington, Natton and Ashchurch (9) Including Monks Lane and Homedowns	Negligible Change	Night-time – 7 increases to above SOAEL from DMOY Night-time - Minor Increase at 9 properties to above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL. The predicted increases at night in the long term are not considered to be significant as no change is observed in the short term. These predicted increases in the long term are considered to be a cumulative significant	Noise barriers have been considered, but would not possible due to access requirements and limited space. No mitigation measures have been proposed, effect is unavoidable.	Cumulative significant adverse effect

Receptors (property count)	DMRB impact magnitude - Short-term (Opening Year 2027)	DMRB impact magnitude - Long-term (Opening Year 2027 to Future Year 2042)	Factors informing significance conclusion	Mitigation Considerations	Conclusion of significance of environmental effect.
			adverse effect, as it did not exist to the same extent with Traffic Scenario S.		
Gloucester Road to Stoke Road, Tredington (24), Orchard View (4)	Negligible Change	Minor Increase Daytime - 7 increases to above SOAEL from DMOY Daytime - Minor Increase at 7 properties above SOAEL Night-time - 15 increases to above SOAEL from DMOY Night-time - Minor Increase at 28 properties above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL. The predicted increases in the long term are not considered to be significant as no change is observed in the short term. These predicted increases in the long term are considered to be a cumulative significant adverse effect, as it did not exist to the same extent with Traffic Scenario S.	Noise barriers have been considered, but would not possible due to access requirements and limited space. No mitigation measures have been proposed, effect is unavoidable.	Cumulative significant adverse effect
Sheldon Cottages (2)	Minor Decrease Daytime - Minor Decrease at 2 properties below SOAEL	Negligible Change	Properties predicted a Minor beneficial change in noise in short-term. The acoustic character of the noise will change, as new slip road screens the M5 and will become the dominant source of noise.	N/A	No significant effect
New House Farm, Moat Lane (1)	Moderate Increase Daytime - Moderate Increase at property	Minor Increase Daytime - Moderate Increase at property	Property predicted a Moderate change in noise below the SOAEL in daytime only. Property 50m from the Scheme, but increase due to demolished properties that were screening noise from the A4019. Property has windows on three other facades and garden to the rear.	Noise barriers have been considered, but would not possible due to access requirements and limited space. No mitigation measures have been proposed, effect is unavoidable.	Cumulative significant adverse effect
The Green and the road to Elmstone Hardwicke (15)	Negligible Change	Daytime - Moderate Increase at 15 properties Night-time - Moderate Increase at 6 properties	Property predicted a Moderate change in noise.	Noise barriers have been considered, but would not feasible due to access requirements, low	Cumulative significant adverse effect

Receptors (property count)	DMRB impact magnitude - Short-term (Opening Year 2027)	DMRB impact magnitude - Long-term (Opening Year 2027 to Future Year 2042)	Factors informing significance conclusion	Mitigation Considerations	Conclusion of significance of environmental effect.
		Night-time - 8 increases to above SOAEL from DMOY	In the short term and DM, this road was considered a 'low flow road' (<1000 vehicles per day). In the future year the traffic is above the threshold but still low. These predicted increases in the long term are considered to be a cumulative significant adverse effect, as it did not exist with Traffic Scenario S.	traffic flow, individual properties and limited space. No mitigation measures have been proposed, effect is unavoidable.	
M5 Barn Farm (1), Informal Traveller site (at least 1)	Minor to Moderate Decrease Daytime - Moderate Decrease at the Informal Travellers Site Daytime - Minor Decrease at Barn Farm above the SOAEL Night-time - Moderate Decrease at the Informal Travellers Site Night-time - Minor Decrease at Barn Farm above the SOAEL	Minor Decrease Daytime - Minor Decrease at all properties, above the SOAEL Night-time - Minor Decrease at all properties, above the SOAEL	Properties predicted a Moderate Decrease in the opening year. Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL.	N/A	Significant beneficial effect
A4019 East of M5 J10 A4019 (39), Homecroft Drive (7), The Green (7), Cooks Lane (1), Sandpiper Drive (3), Coppice Gate (50), Yeend Close (9), Appleyard Close (2), River Leys (12) and Hayden Road (1)	Minor to Major Decrease Daytime - Major Decrease at 42 properties Daytime - Moderate Decrease at 56 properties Daytime - 2 decrease to below SOAEL from DMOY Daytime - Minor Decrease at 19 properties above the SOAEL Night-time - Major Decrease at 37 properties Night-time - Moderate Decrease at 51 properties Night-time – 2 decrease to below SOAEL from DMOY Night-time - Minor Decrease at 32 properties	Minor to Moderate Decrease Daytime - Moderate Decrease at 38 properties Daytime - 9 decreases to below SOAEL from DMOY Daytime - Minor Decrease at 23 properties above the SOAEL Night-time - Moderate Decrease at 29 properties Night-time - 14 decrease to below SOAEL from DMOY Night-time - Minor Decrease at 66 properties	Properties predicted a Minor, Moderate or Major change in noise. Properties directly affected by Scheme design on A4019, including properties within NIA (3948, 3949 and 3950) Many of these properties also exceed the SOAEL.	N/A	Significant beneficial effect
A4019 West of J10 (13) The A4019 including Stanboro Cottage and the Gloucester Old Spot	Minor Increase Daytime - Minor Increase at 3 properties above SOAEL	Minor Increase Daytime - Minor Increase at 13 properties above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL.	Noise barriers have been considered, but would not possible due to access requirements and limited space.	Significant adverse effect

Receptors (property count)	DMRB impact magnitude - Short-term (Opening Year 2027)	DMRB impact magnitude - Long-term (Opening Year 2027 to Future Year 2042)	Factors informing significance conclusion	Mitigation Considerations	Conclusion of significance of environmental effect.
	Night-time - Minor Increase at 6 properties above SOAEL	Night-time - 1 increase to above SOAEL from DMOY Night-time - Minor Increase at 12 properties above SOAEL		No mitigation measures have been proposed, effect is unavoidable.	
Boddington Road/Church Lane (16)	Negligible Change	Minor to Moderate Increase Daytime - Moderate Increase at 6 properties Night-time – 14 increases to above SOAEL from DMOY Night-time - Minor Increase at 16 properties to above SOAEL	Property predicted a Minor to Moderate change in noise. In the short term and DM, this road was considered a 'low flow road' (<1000 vehicles per day). In the future year the traffic is above the threshold but still low. These predicted increases in the long term are considered to be a cumulative significant adverse effect, as it did not exist with Traffic Scenario S or to the same extent in Do Minimum 2042.	Noise barriers have been considered, but would not be feasible due to access requirements, low traffic flow, individual properties and limited space. No mitigation measures have been proposed, effect is unavoidable.	Cumulative significant adverse effect
Bishops Cleeve Charlecote Corner (2), Clematis Court (1), Foxmoor (2), Furlong Lane (2), Grange Drive (2), Green Meadow Bank (1), Haycroft Close (2), Hisnams Field (1), Kingsclere Drive (1), Middlehay Court (5), Church Road (1), Gilders Paddock (1), The Highgrove (1) Sunrise Avenue (1), Greenacre Way (1) and Cheltenham Road (3)	Negligible Change	Minor Increase Daytime - 5 increases to above SOAEL from DMOY Daytime - Minor Increase at 25 properties above SOAEL Night-time - Minor Increase at 7 properties to above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL. The predicted increases in the long term are not considered to be significant as no change is observed in the short term. These predicted increases in the long term are considered to be a cumulative significant adverse effect, as they did not exist to the same extent with Traffic Scenario S.	Noise barriers have been considered, but would not be feasible due to access requirements, low traffic flow, individual properties and limited space. No mitigation measures have been proposed, effect is unavoidable.	Cumulative significant adverse effect
Brockworth Road (28) Including Drews Court and Paynes Pitch junctions with Perrybrook Road, Barrow Hill, Crifty Craft Lane, Belton Drive	Negligible Change	Minor Increase Daytime – 8 increases to above SOAEL from DMOY Daytime - Minor Increase at 12 properties to above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL. These predicted increases in the long term did not exist to the same extent with Traffic Scenario S,	Noise barriers have been considered, but would not be possible due to access requirements and limited space. No mitigation measures have been	No significant effect

Receptors (property count)	DMRB impact magnitude - Short-term (Opening Year 2027)	DMRB impact magnitude - Long-term (Opening Year 2027 to Future Year 2042)	Factors informing significance conclusion	Mitigation Considerations	Conclusion of significance of environmental effect.
		Night-time – 15 increases to above SOAEL from DMOY Night-time - Minor Increase at 28 properties to above SOAEL	however similar changes on these roads have been observed in the Do Minimum 2042.	proposed, effect is unavoidable.	
Cirencester Road (2) and Stilchester Road (2)	Negligible Change	Night-time – 1 increase to above SOAEL from DMOY Night-time - Minor Increase at 4 properties to above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL. The predicted increases in the long term during the night-time only are not considered to be significant as no change is observed in the short term. These predicted increases in the long term are considered to be a cumulative significant adverse effect, as it did not exist to the same extent with Traffic Scenario S.	Noise barriers have been considered, but would not possible due to access requirements and limited space. No mitigation measures have been proposed, effect is unavoidable.	Cumulative significant adverse effect
Down Hatherley Lane (7) Including Clair Cottages	Negligible Change	Night-time – 3 increases to above SOAEL from DMOY Night-time - Minor Increase at 7 properties to above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL. The predicted increases in the long term during the night-time only are not considered to be significant as no change is observed in the short term. These predicted increases in the long term are considered to be a cumulative significant adverse effect, as it did not exist to the same extent with Traffic Scenario S.	Noise barriers have been considered, but would not possible due to access requirements and limited space. No mitigation measures have been proposed, effect is unavoidable.	Cumulative significant adverse effect

Receptors (property count)	DMRB impact magnitude - Short-term (Opening Year 2027)	DMRB impact magnitude - Long-term (Opening Year 2027 to Future Year 2042)	Factors informing significance conclusion	Mitigation Considerations	Conclusion of significance of environmental effect.
Withybridge Lane (8)	Minor to Major Decrease Daytime - Major Decrease at 3 properties Daytime - Moderate Decrease at 1 property Daytime - Minor Decrease at 3 properties above SOAEL Night-time - Moderate Decrease at 2 properties Night-time - Minor Decrease at 5 properties	Minor Decrease Daytime - Minor Decrease at 2 properties above SOAEL Night-time - Minor Decrease at 8 properties	Properties predicted a Minor to Major change in noise. Only façade of properties adjacent to Withybridge Road exceeds the SOAEL, minor increase in noise from link road not significant. Significant benefit observed at 7 properties.	N/A	Significant beneficial effect
Hayden Lane (10) Old Gloucester Road (4)	Minor to Major Decrease Daytime - Major Decrease at 3 properties Daytime - Moderate Decrease at 7 properties Daytime - 1 Minor Decrease to below SOAEL from DMOY Daytime - Minor Decrease at 3 properties above the SOAEL Night-time - Moderate Decrease at 3 properties Night-time - Minor Decrease at 11 properties above SOAEL	Minor Decrease Daytime - 2 Minor Decrease to below SOAEL from DMOY Daytime - Minor Decrease at 2 properties above the SOAEL Night-time - 2 decreases to below SOAEL from DMOY Night-time - Minor Decrease at 11 properties above the SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL. Significant benefit observed at 11 properties	N/A	Significant beneficial effect
Gloucester Road (43) Including Scholars Court and New Penny Court	Minor Increase Daytime - Minor Increase at 30 properties to above SOAEL from DMOY Daytime - Minor Increase at 36 properties above SOAEL Night-time - Minor Increase at 32 properties	Minor Increase Daytime - Minor Increase at 31 properties to above SOAEL from DMOY Daytime - Minor Increase at 36 properties above SOAEL Night-time - Minor Increase at 41 properties above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL.	Noise barriers have been considered, but would not possible due to access requirements and limited space. Traffic speeds are already low so traffic calming measures would not be effective. No mitigation measures have been proposed, effect is unavoidable.	Significant adverse effect
Innsworth Lane (19) & Marleyfield Way (1)	Negligible Change	Minor Increase Daytime - 1 increases to above SOAEL from DMOY Night-time - 20 increases to above SOAEL from DMOY	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL. The predicted increases in the long term only are not considered to be significant as no change is	Noise barriers have been considered, but would not possible due to access requirements and limited space. No mitigation measures have been	Cumulative significant adverse effect

Receptors (property count)	DMRB impact magnitude - Short-term (Opening Year 2027)	DMRB impact magnitude - Long-term (Opening Year 2027 to Future Year 2042)	Factors informing significance conclusion	Mitigation Considerations	Conclusion of significance of environmental effect.
			observed in the short term. These predicted increases in the long term are considered to be a cumulative significant adverse effect, as it did not exist to the same extent with Traffic Scenario S.	proposed, effect is unavoidable.	
Up Hatherley Way/The Reddings (59) Rowan Way (5), Swanscombe Place (2), Manor Park (10), Timperley Way (4), Rothleigh (5), Symphony Road (3), Egdon Crescent (3), Dumbleton Grove (1), Chargrove Lane (1), Rhapsody Court (1), Chasely Crescent (3), Thornhaugh Mews (2), Glyndthorpe Grove (3), Grovefield Way (2), Holst Grove (2), Barrington Avenue (3), North Road West (1), Cold Pool Lane (2), The Reddings (6)	Minor Increase Daytime – 4 increases to above SOAEL from DMOY Daytime - Minor Increase at 4 properties above SOAEL Night-time - Minor Increase at 2 properties above SOAEL	Minor Increase Daytime - 6 increases to above SOAEL from DMOY Daytime - Minor Increase at 6 properties above SOAEL Night-time - 27 increases to above SOAEL from DMOY Night-time - Minor Increase at 52 properties above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL. Similar changes on these roads have been observed in the Do Minimum 2042.	Noise barriers have been considered, but would not possible due to access requirements and limited space. Traffic speeds are already low so traffic calming measures would not be effective. No mitigation measures have been proposed, effect is unavoidable.	No significant effect
Brooklyn Road/Arle Road (59)	Minor Increase Daytime - 1 increase to above SOAEL from DMOY Daytime - Minor Increase at 1 property above SOAEL Night-time - 56 increases to above SOAEL from DMOY Night-time - Minor Increase at 58 properties above SOAEL	Minor Increase Daytime - 1 increase to above SOAEL from DMOY Daytime - Minor Increase at 1 property above SOAEL Night-time - 57 increases to above SOAEL from DMOY Night-time - Minor Increase at 59 properties above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL.	Noise barriers have been considered, but would not possible due to access requirements and limited space. Traffic speeds are already low so traffic calming measures would not be effective. No mitigation measures have been proposed, effect is unavoidable.	Significant adverse effect
Old Road, Southam (2)	Negligible Change	Minor Increase Night-time - 3 increases to above SOAEL from DMOY Night-time - Minor Increase at 5 properties above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL. Not considered significant as no change is observed in short term. Similar changes in noise on this road have been observed in the Do Minimum 2042.	N/A	No significant effect

Receptors (property count)	DMRB impact magnitude - Short-term (Opening Year 2027)	DMRB impact magnitude - Long-term (Opening Year 2027 to Future Year 2042)	Factors informing significance conclusion	Mitigation Considerations	Conclusion of significance of environmental effect.
<p>Telstar Way and Fiddlers Green Lane (42)</p> <p>Including properties on Edendale Approach, Nunney Close, Pheasant Lane, Harthurstfield Park, Meadow Close, Whittle Close, Lazenby Court, Niven Courtyard and Brosnan Drive</p>	Negligible Change	<p>Minor Increase</p> <p>Daytime - 13 increases to above SOAEL from DMOY</p> <p>Daytime - Minor Increase at 23 properties above SOAEL</p> <p>Night-time - 3 increases to above SOAEL from DMOY</p> <p>Night-time - Minor Increase at 42 properties above SOAEL</p>	<p>Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL.</p> <p>In the short term and DM, Telstar Way was considered a 'low flow road' (<1000 vehicles per day). In the future year the traffic is above the threshold but still low. These predicted increases in the long term are considered to be a cumulative significant adverse effect, as it did not exist with Traffic Scenario S.</p> <p>A number of properties fronting Fiddler's Green Lane do not have any windows facing the road, and may not experience the predicted minor increase.</p>	<p>Noise barriers have been considered, but would not possible due to access requirements and limited space.</p> <p>Traffic speeds are already low so traffic calming measures would not be effective. No mitigation measures have been proposed, effect is unavoidable.</p>	Cumulative significant adverse effect
<p>St James Terrace/ Ambrose Street/St Georges Place</p>	<p>Minor to Moderate Decrease</p> <p>Daytime - Moderate Decrease at 17 properties</p> <p>Daytime - 2 Minor Decrease to below SOAEL from DMOY</p> <p>Night -time - Moderate Decrease at 6 properties</p> <p>Night-time - Minor Decrease at 8 properties above SOAEL</p>	<p>Negligible Change</p> <p>Night-time - Minor Decrease at 10 properties above SOAEL</p>	<p>Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL.</p>	N/A	Significant beneficial effect
<p>Bamfurlong Lane including Gloucester Road & Staverton Park (14)</p>	<p>Minor to Moderate Decrease</p> <p>Daytime - Moderate Decrease at 12 properties</p> <p>Daytime - Minor Decrease at 2 properties above SOAEL</p> <p>Night-time - Minor Decrease at 2 properties</p>	<p>Minor Decrease</p> <p>Daytime - Minor Decrease at 4 properties above the SOAEL</p>	<p>Properties predicted a Minor to Moderate change in noise. Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL.</p>	N/A	Significant beneficial effect
<p>Princess Elizabeth Way (230)</p> <p>Including at junctions of Tanners Lane, Dormer Road, Wilson Drive, Edinburgh Place, Kingsmead Avenue, Orchard Way, Orchard Avenue, Anapa Mews, Marsland Road, Queens Place Dowty Road and Village Road</p>	<p>Minor to Moderate Decrease</p> <p>Daytime - 13 Minor Decrease to below SOAEL from DMOY</p> <p>Daytime - Minor Decrease at 230 properties above SOAEL</p>	<p>Minor to Moderate Decrease</p> <p>Daytime - 29 Minor Decrease to below SOAEL from DMOY</p> <p>Daytime - Minor Decrease at 29 properties above SOAEL</p>	<p>Properties predicted a Minor change in noise. Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL.</p>	N/A	Significant beneficial effect

Receptors (property count)	DMRB impact magnitude - Short-term (Opening Year 2027)	DMRB impact magnitude - Long-term (Opening Year 2027 to Future Year 2042)	Factors informing significance conclusion	Mitigation Considerations	Conclusion of significance of environmental effect.
	Night-time – 2 decreases to below SOAEL from DMOY Night-time - Minor Decrease at 86 properties above SOAEL		Includes properties within NIA (3945, NIA 3946 and NIA 3894)		
Hesters Way Road Including at the junctions of Stanley Place, Rushworth Close and Falkland Place	Negligible Change	Minor Decrease Night-time - 3 Minor Decrease to below SOAEL from DMOY Night-time - Minor Decrease at 34 properties above SOAEL	Properties predicted 1dB change in noise adjacent to roads, and noise levels which exceed the SOAEL in the Long Term night-time only. These predicted increases in the long term are considered to be a cumulative significant beneficial effect, as it did not exist with Traffic Scenario S.	N/A	Cumulative Significant Beneficial Effect

6.11. Assumptions and limitations

- 6.11.1. The noise assessment has been carried out using the Scheme information available at the time, including both the design and traffic information.

Construction activity noise

- 6.11.2. Several assumptions and limitations have been identified during the construction assessment. The assessment is considered to represent a reasonable worst case using noise levels from generic construction plant and is considered robust for the purposes of identifying the potential for likely significant adverse effects.
- 6.11.3. The construction noise assessment has predicted the distances at which daytime, evening/weekend and night-time works could be carried out, before exceeding the limit for a significant effect. These distances are considered representative of the worst case for potential noise and vibration impacts for the Scheme route.
- 6.11.4. The on-time for each item of plant was set based on the following:
- 100% for an item that would be in continuous use.
 - 75% for an item that would be in use most of the time.
 - 50% for an item that would be in use some of the time.
 - 25% for an item that would be in use very occasionally.
- 6.11.5. Daytime activities assume a 12-hour working day (07:00 to 19:00). Evening (19:00 to 23:00), weekend and night-time (23:00 to 07:00) works will be avoided where possible. However some essential night-time works will be required at Junction 10 itself, such as during the installation of the new bridge decks and during the demolition of the old bridge, as a minimum. To maximise productivity within the core hours, contractors would require a period of up to one hour before and up to one hour after core working hours for start-up and closedown of activities. This would include but not be limited to deliveries, movement to and from a place of work, unloading, maintenance and general preparation works. This would not include operation of plant or machinery likely to cause a disturbance. These periods have not been considered an extension of 12-hour-working day for the purposes of the assessment of construction activity noise.
- 6.11.6. All calculations assume soft ground attenuation with advice provided on the potential benefit of temporary environmental barriers.
- 6.11.7. The screening effect from existing structures or buildings within the study area was not considered because there were not intervening structures that could provide significant noise attenuation.
- 6.11.8. All calculations are free-field noise levels and do not include a façade correction.

Construction traffic noise

- 6.11.9. It was assumed that the majority of construction traffic would use the A4019 and M5, which currently experience around 20,000 and 100,000 vehicles per day. It is unlikely that the additional construction traffic would affect the existing noise levels.

Construction vibration

- 6.11.10. The properties situated along the A4019, which are very close to the Scheme, have the potential for vibration impacts from the road construction plant, such as planning, milling, breaking, rolling and paving.
- 6.11.11. For the M5, it has been assumed that rotary bored piling will be used to install structures, such as the Piffs Elm Brides and the River Chelt Bridge.
- 6.11.12. The scaling factor for driven piling is assumed to be 1.5 (e.g. piles driven through stiff cohesive soil/compact fill).
- 6.11.13. The predictions of percussive piling assumes hammer energy of 85 kJ.

- 6.11.14. Only steady state vibratory rolling is considered, with a resultant peak particle velocity of 3.7 mm/s for a Bomag 120 at a distance of 10 m.
- 6.11.15. The scaling factor for vibratory rolling is assumed to have a 5% chance of exceedance.
- 6.11.16. A Bomag 120 or similar vibratory roller is assumed for all vibratory rolling.
- 6.11.17. The results of the construction vibration calculations provide a worst-case assessment of construction vibration levels by assuming that the vibration-generating plant is operating at the planned closest point to the sensitive receptors. The worst-case vibration levels would be temporary as the construction works are not fixed in one location for the duration of the build. The risks inherent to the vibration assessment are confined to:
 - The suitability of the construction vibration calculation formulae listed in BS 5228 that are required by the DMRB LA 111
 - The accuracy of guidance levels regarding rotary bored piling in BS 5228
 - The accuracy of manufacturers’ data regarding the Bomag 120.

Operational noise

- 6.11.18. Table 6-34 describes the assumptions and limitations associated with the noise model and the operational noise assessment.

Table 6-34 - Uncertainty in relation to the operational noise assessment

Model element	Assumption and limitations
Traffic data	<ul style="list-style-type: none"> • The level of road traffic noise from the road network has been predicted using the traffic data provided. $L_{A10,18hr}$ and L_{night} traffic noise levels have been predicted using NoiseMap v5.2 noise modelling software, in accordance with CRTN methodology and the modifications and guidance stated in DMRB LA 111. • The noise predictions contain the same inherent assumptions that were built into the traffic model to predict traffic flows, composition, and speed at each link. For a 1dB change to occur, traffic flows need to increase by 25% or decrease by 20% (all other variables being equal). Therefore, small errors in traffic flow forecasts are unlikely to significantly affect results. • The Scheme opening year is assumed to be 2027 and the future year is assumed to be 2042. • Two traffic models were provided, where Scenario S did not include strategic development sites, namely Elm Park. Traffic Scenario R did include this development. • The DMRB LA 111 requires an assessment of night-time noise levels (23:00 to 07:00) using the L_{night} noise index. These were calculated by the noise modelling software using “TRL Method 3”, which calculates L_{night} based on the predicted daytime $L_{A10,18h}$ noise levels as derived from the traffic data.
Road alignments	<ul style="list-style-type: none"> • The road alignments have been modelled based on geo-referenced shapefiles that reflect the design as provided by the project team. • These have been supplemented by OS MasterMap and Google Maps Satellite data.
Road surfaces	<ul style="list-style-type: none"> • All rural roads have been assumed to have a hot-rolled asphalt surface. • Existing road surfacing (pavement) information, plus areas of proposed surface changes (re-surfacing) have been provided by the project pavement team and include the M5. i.e. the M5 includes low noise surfacing on all new and altered sections of the road. However, the GCC roads, such as the A4019 and the Link Road, would not be surfaced with a low noise surfacing. • Surface noise corrections have been implemented in accordance with DMRB LA 111.

Model element	Assumption and limitations
Topography	<ul style="list-style-type: none"> The topography for the study area has been modelled based on a Digital Terrain Model (DTM) supplied by National Highways through the GeoStore. Digital Terrain/Surface Model - ©Astrium Ltd and Bluesky International Ltd. The contours created from the DTM are at 1 metre intervals (vertical resolution). The topography contours modelled for the Scheme were produced based on 3D drawings provided by the Highways engineering team. The topography contours modelled for the Scheme replace the DTM topography at areas within the Scheme boundary for all Do Something scenarios.
Buildings	<ul style="list-style-type: none"> Buildings have been modelled based on OS Mastermap (National Highways Geostore) data. Building heights have been taken to be 6m above ground height. All predictions were carried out at ground and first floor height. Where known, bungalows and caravans were modified to predict at ground floor only.
Noise barriers & fences	<ul style="list-style-type: none"> Scheme noise barriers were included in the noise model, as described in the Mitigation Section
Ground cover	<ul style="list-style-type: none"> Due to the nature of the area surrounding the Scheme, the ground has been modelled as soft and acoustically absorptive.
Address data	<ul style="list-style-type: none"> Address and receptor sensitivity data has been defined from OS AddressBase Plus data and supplemented with online mapping sources.
Survey data	<ul style="list-style-type: none"> The noise survey undertaken in May/June 2021 has been used to inform the noise model and for characterising the sound climate.

6.11.19. Data collection and analysis complemented by the assumptions stated above ensure the robustness of the assessment.

6.12. Chapter summary

6.12.1. A construction and operational noise assessment has been carried out for the M5 Junction 10 Scheme.

Construction noise and vibration

6.12.2. The construction noise assessment determined that a number of representative noise sensitive properties, and other properties in the same area) have the potential for a significant noise effect. Properties that are particularly at risk are those close to the A4019, East of the M5 as well as properties close to the Link Road and any new access roads to individual properties.

6.12.3. With mitigation in place, as well as good community engagement, the impact of the construction noise will be limited. During the day, four of the representative properties are predicted to exceed the threshold value for a moderate or major impact, two of which would also exceed the threshold for noise insulation (Sheldon Cottages and Elm Cottage).

6.12.4. In the evening, this increases to 14 properties, with one additional representative property exceeding the threshold for noise insulation (Stanboro' Cottage). At night-time the number of moderate and major exceedances increases to twenty of the representative properties, with five properties exceeding the threshold for noise insulation, Hollybank, The Green, Maple Lodge, Sandpiper Drive, Hilary and Landrean, plus the properties at River Leys that are 10m from the works. Additionally, there are six representative properties exceeding the threshold for temporary rehousing. These properties are located at Sheldon Cottages, Elm Cottage, Stanboro' and Cremyll. Plus the properties at River Leys and Homecroft Drive that are 25m from the works.

- 6.12.5. In most cases, the roadworks that are very close to a residential property will be transitory in nature and it is unlikely that the moderate or major works would exceed the duration threshold due to the nature of the works. Therefore, construction noise is unlikely to lead to significant effect, including temporary rehousing or noise insulation.
- 6.12.6. Road closures leading to diversion routes would be required for the construction of the two new bridge decks at Junction 10, and removal of the existing A4019 overbridge (requiring M5 road closures over three 12-hour periods). Although the properties within the diversion route study area are likely to experience a major adverse change in noise, the limited duration of the closures would not lead to a significant adverse effect.
- 6.12.7. Additional diversions are expected whilst the M5 J10 slip roads are closed over a 19 month period. A traffic assessment has been carried out, which determined that although the predicted changes in noise on the signed diversion route would be minor at the most, on the A38, the closures of the slip roads could lead to increases in traffic on local roads. This could lead to a significant increase in noise in areas such as Boddington/Staverton, Elmstone Hardwicke and Pamington Lane, where traffic is not following signed diversion routes.
- 6.12.8. Good management of construction traffic and diversion routes in the local area, through the use of the Traffic Management Plan, onto the signed diversion routes would lead to fewer roads being affected by increases in traffic during the closures of the slip roads. However, as it is not possible to make traffic use the signed diversion routes, this measure has not been included in the assessment as an essential mitigation measure. Notwithstanding this fact the Applicant is committed to reducing the effects of the proposed development as far as is reasonably practicable. As such it is proposed to include the signed diversion routes as an additional mitigation measure, during the construction stage, to help reduce some of the impacts felt by local receptors.
- 6.12.9. The levels of construction vibration are likely to lead to a minor to moderate impact during ground compaction, but given the transitory nature of the works, it is unlikely to lead to a significant effect.

Operational noise

- 6.12.10. The noise assessment for the operation of the Scheme in the short term showed significant moderate or major beneficial effects are predicted for 144 residential properties during the day and 98 residential properties during the night. In addition, significant minor beneficial effects, above the Significant Observed Adverse Effect Level (SOAEL), are predicted for 267 residential properties during the day and 175 residential properties during the night. These beneficial effects are predicted where noise barriers have been installed or where changes in traffic flows will cause a reduction in noise levels; including the A4019 (East of the M5 Junction), the M5 and Withybridge Lane, Hayden Lane, St James Terrace, Bamfurlong Lane and Princess Elizabeth Way. Significant beneficial effects are predicted at twelve non-residential receptors (including the House in the Tree PH, the Cheltenham West Fire Station and bars in St James Square) during the day.
- 6.12.11. In contrast, significant moderate or major adverse effects in the short term are predicted for four residential properties during the day (Located at 6 Westfield Cottage, Hardwicke House and Bramble Cottage, on Stoke Road and New House Farm on Moat Lane), with significant minor adverse effects, above the SOAEL, predicted for 85 residential properties during the day and 169 residential properties at night. These changes in noise are predicted at Stoke Road, Brooklyn Road, Up Hatherley Way, Gloucester Road and on the A4019 West of the M5 Junction. Measures to mitigate noise on Stoke Road will be investigated by GCC as a separate project, to be completed in advance of the Scheme opening.
- 6.12.12. In the long term (without the strategic development sites), the Scheme leads to Significant beneficial effects at 46 residential properties during the day and 37 residential properties during the night. In addition, significant minor beneficial effects, above the SOAEL, are predicted for 113 residential properties, and two non-residential, during the day and 163 residential properties during the night. These beneficial effects are predicted where noise barriers have been installed or where changes in traffic flows will cause a reduction in noise levels; including the A4019 (East of the M5 Junction), the M5 and Withybridge Lane, Hayden Lane, St James Terrace, Bamfurlong Lane and Princess Elizabeth Way.

- 6.12.13. Whereas there are no significant adverse moderate or major effects are predicted in the long term. Significant minor adverse effects, above the SOAEL, are predicted for 99 residential properties during the day and 238 residential properties during the night. These properties are located on Stoke Road, A4019 (West of the M5 Junction), Up Hatherley Way, Boddington Road, Gloucester Road and Brooklyn Road.
- 6.12.14. An assessment was also undertaken to consider the future year scenario - when the strategic development sites have been built. The results are broadly similar to the long term assessment, with additional traffic from the strategic development sites at safeguarded land to the north-west of Cheltenham, the North West Cheltenham Development Area and the West Cheltenham Development Area affecting the road network.
- 6.12.15. In the long term, the Scheme with strategic development sites lead to significant beneficial effects at 38 residential properties during the day and 29 residential properties during the night. In addition, significant minor beneficial effects, above the SOAEL, are predicted for 61 residential properties, and one non-residential, during the day and 132 residential properties during the night. These beneficial effects are predicted where noise barriers have been installed or where changes in traffic flows will cause a reduction in noise levels; including the A4019 (East of the M5 Junction), the M5 and Withybridge Lane, Hayden Lane, St James Terrace, Bamfurlong Lane and Hesters Way Road.
- 6.12.16. Whereas, in this long term scenario, significant adverse effects are predicted for 23 residential properties during the day and 3 residential properties at night. These properties are located at Boddington Road/Church Lane, The Green/ Road to Elmstone Hardwicke and Moat Lane. Significant minor adverse effects, above the SOAEL, are predicted for 179 residential properties during the day and 433 residential properties during the night. These properties are located on Fiddlers Green Lane, Down Hatherley Lane, Cirencester Road, Brockworth Road and Innworth Lane, as well as in Bishops Cleeve, and on the road network between Stoke Orchard and Ashchurch (through Fiddington and Natton). Significant adverse effects are predicted during the day at three non-residential receptors, located at the Orchard, the Village Hall Uckington and the Church of St Mary Magdalene.

Appendices



Appendix 6.1 – Noise chapter figures and data

Appendix 6.1 – Noise Chapter Figures and Data is provided as a separate document (application document TR010063 – APP 6.15).

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