

A46 Coventry Junctions (Walsgrave)

Scheme number: TR010066

6.1 Environmental Statement

Chapter 14 - Climate

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**ENVIRONMENTAL STATEMENT
Chapter 14 - Climate**

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Author	A46 Coventry Junctions (Walsgrave), Project Team, National Highways

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14. Climate

14.1. Introduction

- 14.1.1. This Chapter presents the information required by the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (as amended) to be provided in the Environmental Statement (ES) to enable the identification and assessment of likely significant effects on climate.
- 14.1.2. As part of the Environmental Impact Assessment (EIA) process, this Chapter reports the potential significant effects for climate, as a result of the Scheme. This assessment includes a review of the existing climate information to define the baseline conditions, consideration of the potential impacts of the Scheme and its resilience to the future impacts of a changing climate, then identification of proportionate mitigation where appropriate and an assessment of the significance of any residual effects.
- 14.1.3. To align with the requirements of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (EIA Regulations) and guidance from Design Manual for Roads and Bridges (DMRB) LA 114: Climate (Highways England, 2021) (hereafter referred to as DMRB LA 114), consideration of climate effects is divided into two aspects:
- 14.1.4. Greenhouse gas impact assessment - impacts on climate from carbon emissions arising from the Scheme, including whether the Scheme may affect the ability of the UK Government to meet its carbon reduction targets (in accordance with the updated version of National Networks National Policy Statement (NPS NN) (Department for Transport (DFT), May 2024).
- 14.1.5. Climate change resilience assessment - the ability of the Scheme to operate as intended despite climate change impacts and associated weather effects, including how the Scheme considers climate change projections (in accordance with NPS NN 2024 and the EIA Regulations).
- 14.1.6. The term 'carbon' is used as shorthand to refer to all relevant greenhouse gas emissions.
- 14.1.7. ES Chapter 2 (The Scheme) (**TR010066/APP/6.1**) contains a detailed description of the Scheme. The figures referenced in this Chapter can be found in the ES Figures (**TR010066/APP/6.2**). This Chapter text is supported by the following appendix:
- Appendix B.8 Outline Carbon Management Plan of the First Iteration Environmental Management Plan (EMP) (**TR010066/APP/6.5**)

14.2. Competent expert evidence

14.2.1. This Chapter has been prepared by a team of competent experts. The lead author has over 10 years' experience in carbon assessment and has a PhD in Environmental Engineering with a focus on low carbon concrete. The experts have used their EIA knowledge, experience with infrastructure projects and professional judgement in considering the likely significant effects associated with the Scheme and providing technical guidance through the assessment process.

14.3. Legislative and policy framework

Legislation

14.3.1. The main legislative framework for climate includes the following regulations, presented in Table 14.1. These have been taken into account when assessing the potential effects on climate.

Table 14.1 Summary of legislation relevant to the climate assessment

Legislation or regulation	Summary	How it is dealt with in this assessment
United Nations Framework Convention on Climate Change (UNFCCC)	<p>Signed in 1992, the UNFCCC is the foundational treaty that has provided a basis for international climate negotiations since it was established, including landmark agreements such as the Kyoto Protocol (1997) and the Paris Agreement (2015). The Convention has been ratified by 197 states who have committed to act on climate change and regularly report on their progress.</p> <p>The key objective of the Convention was the <i>"stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system"</i> within a timeframe that allows people and planet to adapt and economies to develop sustainably.</p>	The greenhouse gas impact assessment has been undertaken as part of this legislation in order to keep the greenhouse gas concentrations in the atmosphere at a level to prevent any damage to the climate system.
Kyoto Protocol, 1997	<p>With 192 signatories currently, the Kyoto Protocol was adopted on 11 December 1997, and it entered into force on 16 February 2005 and ran till 2015, before being superseded by the Paris Agreement (2015). The objective of the Kyoto Protocol was to operationalise the UNFCCC by committing industrialised countries and economies in transition to limit and reduce greenhouse gas emissions in accordance with agreed individual targets. The Convention itself only asks those</p>	The greenhouse gas impact assessment has been undertaken as part of this legislation in order to minimise the effects from carbon and mitigate emissions.

Legislation or regulation	Summary	How it is dealt with in this assessment
	countries to adopt policies and measures on mitigation and to report periodically	
Paris Agreement, 2015	<p>The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 Parties at the UN Climate Change Conference (COP21) in Paris, France, on 12 December 2015. It entered into force on 4 November 2016.</p> <p>Its overarching goal is to hold <i>“the increase in the global average temperature to well below 2°C above pre-industrial levels”</i> and pursue efforts <i>“to limit the temperature increase to 1.5°C above pre-industrial levels.”</i> The Paris Agreement is a landmark in the multilateral climate change process because, for the first time, a binding agreement brings all nations together to combat climate change and adapt to its effects.</p> <p>In December 2020, the United Kingdom of Great Britain and Northern Ireland (the UK) communicated its Nationally Determined Contribution (NDC) to the UNFCCC in line with Article 4 of the Paris Agreement. In its NDC, the UK commits to reducing economy-wide greenhouse gas emissions by at least 68% by 2030, compared to 1990 levels. This has been further strengthened and detailed since the COP26 in Glasgow.</p>	The greenhouse gas impact assessment has been undertaken as part of this legislation in order to determine the impact of the Scheme on climate change to help mitigate that impact to limit the temperature increase to 1.5°C above pre-industrial levels and mitigate greenhouse gas emissions.
Climate Change Act 2008, (as amended)	<p>The Climate Change Act 2008 is essential to UK Government's plan to reduce carbon emissions, committing the UK to a reduction of 80% against 1990 levels by 2050. On 1 May 2019, the UK Government declared a climate emergency, leading to updating the commitments in the 2008 Act to target net zero carbon emissions by 2050 under the Climate Change Act (2050 Target Amendment) Order 2019. A revision of the target has been produced and states that <i>“the minimum percentage by which the net UK carbon accounts for the year 2050 must be lower than the 1990 baseline is increased from 80% to 100%”</i>.</p> <p>A key provision of the Climate Change Act 2008 is the requirement for the government to set legally binding carbon budgets limiting the amount of carbon emitted in the UK over a five-year period. The six budgets developed</p>	The greenhouse gas impact assessment has been undertaken as part of this legislation and the impact of greenhouse gas emissions have been assessed against the carbon budget published by the Climate Change Act 2008.

Legislation or regulation	Summary	How it is dealt with in this assessment
	<p>currently cover the period to 2037 and were issued prior to the revision to the 2050 target in the Climate Change Act. The UK is currently in the fourth carbon budgetary period (2023-2027), the budget for which is 1,950 MtCO₂e net. The Sixth Carbon Budget enshrined in law in June 2021 is the first budget to take account of the UK Government's 2050 net zero target.</p> <p>The Climate Change Act 2008 establishes a framework to facilitate climate change adaptation. This includes a requirement for the government to report, at least every five years, on climate change risks to the UK, and to publish a programme setting out how these will be addressed. The Committee on Climate Change, to both advise and critically review the Government's adaptation work.</p>	
National Planning Practice Guidance (NPPG): Climate (Department for Levelling Up, Housing and Communities, and Ministry of Housing, Communities and Local Government, 2019)	This guidance advises Local Planning Authorities on how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change.	<p>This Chapter identifies possible changes in climate (Section 14.8 of this Chapter), the potential impacts associated with these changes (Section 14.9 of this Chapter) and the measures embedded within the design of the Scheme to mitigate these impacts (Section 14.10 of this Chapter).</p> <p>Section 14.11 of this Chapter provides an assessment of the residual risk of each impact based on the assumed likelihood and consequence of each potential impact occurring.</p> <p>As identified in Section 14.10 of this Chapter, a number of mitigation measures have been or would be implemented in order to reduce greenhouse gas emissions associated with the Scheme.</p>

Plans and Strategies

14.3.2. A number of plans and strategies have been published which are relevant to this aspect.

Net Zero Strategy: Build Back Greener (HM Government 2021).

14.3.3. This strategy sets out the UK's approach to meeting UK carbon budgets, its 2030 Nationally Determined Contribution and net zero by 2050. As such, it includes:

- Decarbonisation pathways to net zero by 2050, including illustrative scenarios
- Policies and proposals to reduce greenhouse gas emissions for each sector
- Cross-cutting action to support the transition

14.3.4. The High Court declared that this strategy was unlawful on 15 July 2022. This strategy was not quashed, however, and the UK Government subsequently released the Powering Up Britain paper described below.

Powering up Britain (Department for Energy Security and Net Zero (DESNZ 2023a).

14.3.5. This paper provides an update to the 2021 Net Zero Strategy and sets out the UK Government's plan for transitioning towards domestic energy sources and for achieving net zero by 2050. It has two parts: the Energy Security Plan and the Net Zero Growth Plan. The Net Zero Growth Plan:

- Sets out actions for investments into green industries such as offshore wind, carbon capture, usage and storage, and nuclear
- Identifies actions towards meeting the UK's carbon budgets and acts as an annual update against the Net Zero Strategy
- Meets the UK Government's statutory obligations under the Climate Change Act (2008) to:
 - - Respond to the Climate Change Committee's 2022 Progress Report to Parliament and
 - - Provide a Carbon Budget Delivery Update (i.e., the Carbon Budget Delivery Plan)

14.3.6. In relation to the reduction of emissions from domestic road transport, the Net Zero Growth Plan provides a progress and delivery update on the phasing out of the sale of new non-zero emission road vehicles and the development of the UK's charging infrastructure network, in addition to increasing levels of cycling and walking.

Carbon Budget Delivery Plan (DESNZ, 2023b).

- 14.3.7. This Plan, published alongside the Net Zero Growth Plan and Energy Security Plan, sets out a package of proposals and policies, and associated timescales and delivery risks, that enable Carbon Budgets 4-6 to be met.

National Policy

National Networks National Policy Statement, 2024

- 14.3.8. The National Networks National Policy Statement (NPS NN) sets out the policy which the Scheme should comply with. It is also the basis for informing a judgement on the impacts of a Scheme, for example whether the Scheme is consistent with the requirements of the NPS NN. Compliance of the Scheme with the NPS NN is detailed within the NPS NN Accordance Tables (TR010066/APP/7.2).
- 14.3.9. In the current NPS NN, greenhouse gas emissions, measured as carbon dioxide equivalent, are referred to as “*carbon emissions*”, as outlined in Paragraph 5.26 of NPS NN.
- 14.3.10. The policies of relevance to climate within the NPS NN and detail on how they have been addressed in the assessment are summarised in Table 14.2.

Table 14.2 Summary of NPS NN planning policies of relevance to climate.

NPS NN 2024 Paragraph Number	Summary	How this policy is addressed in the assessment
4.35	<i>“Article 7 of the Paris Agreement establishes a global goal on adaption – of enhancing adaptive capacity, strengthening resilience, and reducing vulnerability to climate change in the context of temperature goal of the Agreement. It aims to significantly strengthen national adaption efforts, including through support and international cooperation.”</i>	The Scheme has been designed with respect to commitments set out in the Paris Agreement (2015). This Chapter considers the Scheme’s effect on climate (i.e. increases in carbon emissions) as well as the potential vulnerability of the Scheme to climate change (i.e. the resilience of Scheme assets to projected changes in climate).
4.36	<i>“To support planning decisions, the government produces a set of UK Climate Projections and has developed a National Adaption Programme. In addition, the government’s Adaption Reporting Power invites authorities (a defined list of public bodies and statutory undertakers, including National Highways, Network Rail and the Office for Rail and Road) to assess the risks</i>	The Scheme has been designed with respect to commitments set out in the Paris Agreement (2015). This Chapter considers the Scheme’s effect on climate (i.e. increases in carbon emissions) as well as the potential vulnerability of the Scheme to climate change (i.e. the resilience of Scheme assets to projected changes in climate).

NPS NN 2024 Paragraph Number	Summary	How this policy is addressed in the assessment
	<i>presented by a changing climate, include policies and actions to address climate risk and set out progress made.”</i>	The risks posed by climate change have been reported within the Climate Change Resilience Assessment section of this Chapter.
4.38	<i>“In preparing the measures to support climate change adaption applicants should consider whether nature-based solutions could provide a basis for such adaption. In addition to avoid further carbon emissions when compared with some more traditional adaption approaches, nature-based solutions can also result in biodiversity benefits as well as increasing absorption of carbon dioxide from the atmosphere (see also paragraphs 5.190 to 5.203) on the role of green infrastructure).”</i>	<p>The Scheme has been designed with respect to commitments set out in the Paris Agreement (2015). This Chapter considers the Scheme’s effect on climate (i.e. increases in carbon emissions) as well as the potential vulnerability of the Scheme to climate change (i.e. the resilience of Scheme assets to projected changes in climate).</p> <p>An Outline Carbon Management Plan, Appendix B.8 of the First Iteration EMP (TR010066/APP/6.5) has been produced for the Scheme which outlines different mitigation measures to minimise the carbon emissions from construction. This says priority should be given to low-carbon solutions that promote network and system decarbonisation as far as possible (including nature-based solutions). A Carbon Management Report will be prepared at the end of each work stage and follow National Highways guidance. This will include opportunities to include the embedment of nature-based solutions and technological solutions to mitigate, capture or offset the emissions of construction.</p>
5.34	<i>“As referenced in the Transport Analysis Guidance, the guiding principles of managing whole life carbon are established in PAS 2080: Carbon Management in Buildings and Infrastructure (2023). This demonstrates how the whole value chain can support infrastructure decarbonisation.”</i>	A Whole Life Carbon Assessment has been undertaken which reports the total estimated greenhouse gas emissions arising from the Scheme for the construction, operation and overall total for the whole lifecycle. The Whole Life Carbon Assessment has been conducted according to PAS 2080:2023 and DMRB LA 114 as outlined in the methodology and the results of the assessment have been reported in this Chapter. This includes the use of Web-based Transport Analysis Guidance (WebTAG) and the TAG database.

NPS NN 2024 Paragraph Number	Summary	How this policy is addressed in the assessment
5.35	<p><i>“Having regard to current knowledge, a carbon management plan should be produced as part of the Development Consent Order submission and include:</i></p> <ul style="list-style-type: none"> <i>• a Whole Life Carbon Assessment for the project</i> <i>• an explanation of the steps that have been taken to drive down the carbon impacts of the project</i> <i>• how construction and operational emissions and, where applicable, emissions from maintenance activities, have been reduced as much as possible using the carbon reduction hierarchy (e.g. as set out in PAS 2080) (recognising that the case of road projects while the developer can estimate the likely emissions from road traffic, it is not solely responsible for controlling them).</i> <i>• whether and how any residual emissions will be (voluntarily) offset or removed using a recognised framework (any offsetting of emissions should not be used in the Whole Life Carbon Assessment headline figures)</i> <i>• where there are residual emissions, the level of emissions and the impact of those on relevant statutory carbon budgets.”</i> 	<p>A Whole Life Carbon Assessment has been undertaken which reports the total estimated greenhouse gas emissions arising from the Scheme for the construction, operation and overall total for the whole lifecycle. The Whole Life Carbon Assessment has been conducted according to PAS 2080:2023 and DMRB LA 114 as outlined in the methodology and the results of the assessment have been reported in this Chapter.</p> <p>An Outline Carbon Management Plan, Appendix B.8 of the First Iteration EMP (TR010066/APP/6.5), has been produced for the Scheme and Section 14.10 outlines different mitigation measures to minimise the carbon emissions from construction and operation.</p>
5.36	<p><i>“Applicants should look for opportunities within the design of the proposed development to embed nature-based or technological solutions to mitigate, capture or offset the emissions of construction.”</i></p>	<p>The Scheme includes nature-based solutions and these are presented on the Environmental Masterplan (ES Figure 2.4 (TR010066/APP/6.2)). The Environmental Masterplan has been developed with ecologists to increase biodiversity, including the provision of sustainable drainage systems and woodland creation. Refer to ES Chapter 8 (Biodiversity) (TR010066/APP/6.1).</p> <p>An Outline Carbon Management Plan, Appendix B.8 of the First Iteration EMP (TR010066/APP/6.5), has been produced for the Scheme and Section 14.10 outlines different mitigation measures to minimise the carbon emissions from construction and operation.</p> <p>A Carbon Management Report will be prepared at the end of each work stage and follow National Highways guidance. This will include opportunities to include</p>

NPS NN 2024 Paragraph Number	Summary	How this policy is addressed in the assessment
		the embedment of any further nature-based solutions and technological solutions to mitigate, capture or offset the emissions of construction.
5.37	<i>“Steps taken to minimise, capture and offset emissions in design and construction, should be set out in the carbon management plan, secured under the Development Consent Order. This could include, for example, mitigation through woodland creation on or adjacent to the site contributing to offsetting residual emissions. Applicants may wish to refer to the Institute of Environmental Management and Assessment Greenhouse Gas Management Hierarchy guidance when drafting their application.”</i>	An Outline Carbon Management Plan, Appendix B.8 of the First Iteration EMP (TR010066/APP/6.5), has been produced for the Scheme and Section 14.10 outlines different mitigation measures to minimise the carbon emissions from construction and operation. All steps to reduce the carbon emissions from the scheme have been outlined in the Design, mitigation and enhancement measures section of this Chapter.
5.38	<i>“The Secretary of State must be satisfied that the applicant has as far as possible assessed carbon emissions at all stages of the development. The Secretary of State for Energy and Net Zero regularly assesses whether the UK has sufficient policies and proposals overall to meet the UK carbon budgets, with a view to meeting the net zero target, in line with the duties under Section 13 of the Climate Change Act 2008. It would not be feasible or sensible for such an assessment to be done at the time of taking individual development decisions, and there is no legal requirement to do so.”</i>	A Whole Life Carbon Assessment has been undertaken which reports the total estimated greenhouse gas emissions arising from the Scheme for the construction, operation and overall total for the whole lifecycle. The Whole Life Carbon Assessment has been conducted according to PAS 2080:2023 and DMRB LA 114 as outlined in the methodology and the results of the assessment have been reported in this Chapter.
5.39	<i>“S.1(1) of the Climate Change Act 2008 reflects and puts into effect the net zero target set in light of the temperature goal of the Paris Agreement. The target was increased from 80% emission reductions by 2050 to 100% emission reductions by 2050 in June 2019. Carbon budgets 1 to 5 were set to meet the 80% emission reduction target, but carbon budget 6 (2033-2037) has been set to meet the 2050 net zero target, so it is more stretching. The UK’s current Nationally Determined Contribution (set in line with Article 4 of the Paris Agreement) commits to reducing economy-wide greenhouse gas emissions by at least 68% by 2030, compared to 1990 levels, so it is</i>	This Chapter illustrates the increase in carbon emissions resulting from the Scheme represents up to approximately 0.003% of relevant carbon budgets over their respective periods. Comparison between the increase in the Scheme emissions and published carbon budgets, following DMRB LA 114 guidance on determining significance, can only be undertaken for approximately 19% of the emissions increase. The remaining 81% of the increase in carbon emissions will occur after 2038 (the end of the last currently published UK carbon budget). For both

NPS NN 2024 Paragraph Number	Summary	How this policy is addressed in the assessment
	<i>more stretching than carbon budget 5. The UK's Nationally Determined Contribution is on the pathway to the 2050 net zero target. Where it provides useful context, applicants may wish to compare their scheme emissions against carbon budgets, next zero and the Nationally Determined Contribution. Where an applicant assesses the carbon impacts of its scheme against carbon budget 6, and later carbon budgets, it is to be taken also to have assessed the scheme against the net zero target in the Climate Change Act 2008, as they are line with this target."</i>	construction and operational effects on climate, it is unlikely that the Scheme will result in greenhouse gas emissions that would be defined as significant considering the greenhouse gas emissions from the Scheme are unlikely to have a material impact on the Government achieving its carbon targets.
5.40	<i>"The Secretary of State should be content that the applicant has taken all reasonable steps to reduce carbon emissions at all stages of the development. The Secretary of State should also give positive weight to projects that embed nature-based or technological processes to mitigate or offset the emissions of construction and within the proposed development. However, given the important role national network infrastructure plays in supporting the process of economy wide decarbonisation, the Secretary of State accepts that there are likely to be some residual emissions from construction of national network infrastructure."</i>	<p>A Whole Life Carbon Assessment has been undertaken which reports the total estimated greenhouse gas emissions arising from the Scheme for the construction, operation and overall total for the whole lifecycle. The Whole Life Carbon Assessment has been conducted according to PAS 2080:2023 and DMRB LA 114 as outlined in the methodology and the results of the assessment have been reported in this Chapter.</p> <p>The Scheme includes nature-based solutions and these are presented on the Environmental Masterplan (ES Figure 2.4 (TR010066/APP/6.2)). The Environmental Masterplan has been developed with ecologists to increase biodiversity, including the provision of sustainable drainage systems and woodland creation. Refer to ES Chapter 8 (Biodiversity) (TR010066/APP/6.1).</p> <p>A Carbon Management Report will be prepared at the end of each work stage and follow National Highways guidance. This will include opportunities to include the embedment of any further nature-based solutions and technological solutions to mitigate, capture or offset the emissions of construction.</p>
5.41	<i>"Operational carbon emissions from some types of national network infrastructure cannot be totally avoided. Given the range</i>	This Chapter demonstrates the construction, operation and use of the Scheme is predicted to increase carbon

NPS NN 2024 Paragraph Number	Summary	How this policy is addressed in the assessment
	<i>of non-planning policies aimed at decarbonising the transport system, government has determined that net increase in operational carbon emissions is not, in itself, reasons to prohibit the consenting of national network projects or to impose more restrictions on them in the planning policy framework.”</i>	emissions by approximately 377,791 tCO ₂ e over the appraisal period of 60 years (up to 2087). However, the contributions of the Scheme to the UK's carbon budget for the relevant carbon budget periods are not significant, less than 0.003%, and therefore it can be concluded that the greenhouse gas emissions impact of the Scheme would not have any material impact on the UK Government meeting its legally binding carbon reduction targets.
5.42	<i>“Any carbon assessment will include an assessment of operational greenhouse gas emissions, but the policies set out in Chapter 2 of the NPS, apply to these emissions. Operational emissions will be addressed in a managed, economy wide manner, to ensure consistency with carbon budgets, net zero and our international climate commitments. Therefore, approval of schemes with residual carbon emissions is allowable and can be consistent with meeting net zero. However, where the increase in carbon emissions resulting from the proposed scheme are so significant that it would have a material impact on the ability of government to achieve its statutory carbon budgets, the Secretary of State should refuse consent.”</i>	<p>A Whole Life Carbon Assessment has been undertaken which reports the total estimated greenhouse gas emissions arising from the Scheme for the construction, operation and overall total for the whole lifecycle. The Whole Life Carbon Assessment has been conducted according to PAS 2080:2023 and DMRB LA 114 as outlined in the methodology and the results of the assessment have been reported in this Chapter.</p> <p>All steps to reduce the carbon emissions from the scheme have been outlined in the design, mitigation and enhancement measures section of this Chapter.</p> <p>This Chapter demonstrates the construction, operation and use of the Scheme is predicted to increase carbon emissions by approximately 377,791 tCO₂e over the appraisal period of 60 years (up to 2087). However, the contributions of the Scheme to the UK's carbon budget for the relevant carbon budget periods are not significant, less than 0.003%, and therefore it can be concluded that the greenhouse gas emissions impact of the Scheme would not have any material impact on the UK Government meeting its legally binding carbon reduction targets.</p>

National Planning Policy Framework

- 14.3.11. The National Planning Policy Framework (NPPF) (December 2023) sets out the Government's planning policies for the whole of England, including the Government's expectation for content and quality of planning applications and local plan policy. The overall strategic aims of the NPS NN and NPPF are consistent. The NPPF may be an important and relevant matter but does not form the basis for a decision on an NSIP.
- 14.3.12. The NPPF seeks to promote a strong and competitive economy with Local Plans identifying *"priority areas for economic regeneration, infrastructure provision, and environmental enhancement"*. In addition, the NPPF seeks to promote sustainable transport by encouraging solutions which support reductions in greenhouse gas emissions and reduce congestion.
- 14.3.13. The NPPF does not contain specific policies for NSIPs (paragraph 5). NSIPs are determined in accordance with the decision-making framework set out in the Planning Act 2008 and relevant National Policy Statements for major infrastructure (the NPS NN in the case of the Scheme). The NPS NN explains that its strategic objectives are consistent with those of the NPPF and Paragraph 1.10 of the NPS NN states that the NPPF may be an important and relevant consideration in NSIP decision making.

Local Policy

- 14.3.14. In addition to national planning policies, the Scheme has taken into account the requirements of regional and local planning policies in the assessment and management of climate as presented in Table 14.3.

Table 14.3 Summary of local planning policies of relevance to climate.

Planning policy	Summary	How it is addressed with in this assessment
West Midlands Combined Authority: Five Year Plan (2021 – 2026)	<i>"Under a highly ambitious Accelerated scenario, goals in domestic, commercial, industrial, transport and land use sectors could deliver a 33% reduction by 2026 (against 2016 baseline) and net zero by 2041"</i> .	This Chapter, Section 14.5, illustrates how the Scheme would support this goal of net zero by 2041 by assessing its greenhouse gas emissions in the Scheme's opening year of 2028 and design year of 2043 to recommend mitigation measures to limit / further reduce greenhouse gas emissions as part of National Highways' policy to achieve net zero, as outlined below this table in Section 14.3.6 – 14.3.8.
	The scope of carbon emissions is <i>"to estimate carbon emissions from the seven constituent local authorities... targeting and monitoring carbon"</i>	An Outline Carbon Management Plan, Appendix B.8 of the First Iteration EMP (TR010066/APP/6.5), outlines the framework for managing and reducing the greenhouse gas emissions the Scheme. This

Planning policy	Summary	How it is addressed with in this assessment
	reduction"	document outlines the project-specific context as well as the carbon quantification methodology, carbon target review and the development of carbon mitigation strategies, of which all are required to be implemented from DCO application design through to construction and operation of the Scheme.
Coventry City Council Local Development Plan (adopted December 2017)	Policy DS3 of the Coventry Local Plan outlines the Council's presumption in favour of sustainable development contained in the NPPF. The Council states <i>"it will work proactively with applicants to find solutions to enable proposals to be approved wherever possible, and to secure development that improves the economic, social and environmental conditions in the area."</i>	An Outline Carbon Management Plan, Appendix B.8 of the First Iteration EMP (TR010066/APP/6.5), outlines the methodology to identify opportunities to reduce carbon emissions that would also offer opportunities for economic, social and environmental improvements, such as creating wetland habitats, promoting low carbon material use and investing in carbon innovations.
	Policy DE1 states all developments are expected to <i>"be proactive in responding to climate change and adopt sustainable and low carbon construction principles in terms of their design, layout and density"</i>	The Scheme has been designed to prevent consequential impacts from adaptation measures. The adaptation measures have been discussed within the design, mitigation and enhancement measures section this Chapter. An Outline Carbon Management Plan Appendix B.8 of the First Iteration EMP (TR010066/APP/6.5) has also been submitted as part of the Application, it outlines the framework for managing and reducing the greenhouse gas emissions for the Scheme. The Outline Carbon Management Plan outlines the project-specific context as well as the carbon quantification methodology, carbon target review and the development of carbon mitigation strategies, of which all are required to be implemented from DCO application design through to construction and operation of the Scheme.
	Policy EM1 states <i>"all development is required to be designed to be resilient to, and adapt to the future impacts of, climate change"</i>	This Chapter, Section 14.10, outlines the climate resilience assessment.
	Policy EM1 states <i>"applicants will be required to set out how the requirements of the policy have been complied with including justification for why... measures have not been incorporated"</i>	The Outline Carbon Management Plan, Appendix B.8 of the First Iteration EMP (TR010066/APP/6.5), states the reporting requirements throughout project lifecycle.
	Policy EM5 states <i>"all development must apply SuDS and should ensure that surface water runoff is managed"</i>	Climate change has been considered in the drainage design in accordance with DMRB LA 114 and current government guidance. The details are in ES Appendix

Planning policy	Summary	How it is addressed with in this assessment
	<i>as close to source as possible"</i>	13.1 (Flood Risk Assessment) (TR010066/APP/6.3).
	Policy EM8 states that <i>"Development proposals should demonstrate measures to minimise the generation of waste in the construction, use and life of buildings and promote more sustainable approaches to waste management, including the reuse and recycling of construction waste and the promotion of layouts and designs that provide adequate space to facilitate waste storage, reuse, recycling and composting."</i>	The Outline Carbon Management Plan, Appendix B.8 of the First Iteration EMP (TR010066/APP/6.5), details the carbon management hierarchy which will be applied. Within this is 'Improve' which considers circular economy principles. The Outline Carbon Management Plan also highlights that the questions related to re-use and waste minimisation will be raised in the carbon reduction workshops. Waste carbon emissions will be reported at agreed intervals throughout the project.
Rugby Borough Council Local Plan 2011-2031 (adopted June 2019)	Rugby Borough Council: Local Plan 2011-2031 states development will be accommodated where it supports decarbonisation and protect or enhances the area.	This Chapter illustrates how the Scheme would consider how to enhance and protect the area by supporting decarbonisation and reducing carbon emissions.
	Spatial objective, Section 2.23, point 9 <i>"Ensure the challenges of climate change are met by utilising the renewable energy resources present in the Borough, improving the energy efficiency of existing development and ensuring the urban extensions achieve high sustainability standards"</i>	The Outline Carbon Management Plan, Appendix B.8 of the First Iteration EMP (TR010066/APP/6.5), details the carbon management hierarchy which will be applied. Within this is 'Switch' which adopts solutions which use low carbon technologies. It outlines that priority should be given to low-carbon solutions that promote network and system decarbonisation as far as possible.
	Chapter 10, Section 10.2, <i>"Climate change is a major, global issue and Rugby Borough must take steps to reduce the causes and make plans to respond to the effects at the local level. New development in the Borough must also take into account the consequences of climate change and ensure development is adaptable to changing conditions over its lifetime."</i>	The Scheme has been designed to prevent consequential impacts from adaptation measures. The adaptation measures have been discussed within the Design, mitigation and enhancement measures section this Chapter. An Outline Carbon Management Plan, Appendix B.8 of the First Iteration EMP (TR010066/APP/6.5) has also been submitted as part of the Application, it outlines the framework for managing and reducing the greenhouse gas emissions the Scheme. This document outlines the project-specific context as well as the carbon quantification methodology, carbon target review and the development of carbon mitigation strategies, of which all are required to be implemented from DCO application design through to construction and operation of the Scheme.

National Highways policy

National Highways Net zero highways: 2030 / 2040 / 2050 plan (2021)

14.3.15. National Highways have outlined their net zero strategy to achieve net zero:

- Corporate emissions – net zero by 2030
- Maintenance and construction emissions – net zero by 2040
- Road user emissions – net zero by 2050

14.3.16. To enable net zero by 2040 for construction and maintenance the following interim targets are proposed:

- A trajectory of 0-10% reduction by 2025
- A 40%-50% reduction by 2030
- A 70-80% reduction by 2035
- Net Zero by 2040 against a 2020 baseline

14.3.17. National Highways target the use of only zero carbon plant on their sites by 2030. The Scheme will directly affect the maintenance and construction emissions of National Highways.

National Highways: Preparing for climate change on the strategic road network – third adaptation report under the Climate Change Act (2008)

14.3.18. The third report, published under the Climate Change Act's (2008) Adaptation Reporting Power (ARP):

- Re-evaluates significant climate risks threatening the safe operation of England's strategic road network (SRN) using more up-to-date climate projections.
- Assesses progress against previously identified adaptation actions.
- Identifies areas for improvement and appropriate actions.

14.3.19. Building on advice from the Climate Change Committee's CCRA3 report, the report aims to address the increased risk brought to the UK's strategic road network with the overarching vision that in 2050 "*The SRN is resilient to climate change and incidents, such as flooding, poor weather conditions, blockages on connecting transport networks*". The report carries out a risk assessment of likely highways impacts which include, but are not limited to:

- Overwhelming of drainage due to fluvial (river) and pluvial (surface) and groundwater flooding.
- Ground saturation affecting stability of geotechnical assets.

- Destabilisation of earthworks due to standing water.
- Waterlogging of pavement surface.

National Highways: Strategic Business Plan 2020-2025 (2020)

14.3.20. The Strategic Business Plan 2020-2025 sets out National Highways' response to the Government's second Road Investment Strategy (RIS2). It presents the careful balancing between maintaining and operating the strategic road network (SRN) safely and providing new capacity where it is needed. It supports the Government's ambition to achieve net zero UK carbon emissions by 2050. It notes that National Highways has a shared responsibility to tackle climate change and is dedicated to minimising the greenhouse gas emissions generated from the activities within National Highways' control including designing schemes and services to be carbon and energy efficient, reducing carbon footprint through initiatives such as introducing energy-saving measures for maintenance depots and using low-energy lighting and control systems for motorways.

Topic-specific guidance

British Standards Institution: PAS 2080:2023 Carbon Management in Infrastructure

14.3.21. The updated PAS 2080:2023 specification summarises the requirements for all value chain members to best control and influence whole-life carbon management at the asset, network, and system levels. Value chain requirements are structured around the following components:

- Effective leadership
- Maximising opportunities for whole life carbon reductions at all stages of the delivery process
- Selecting appropriate carbon emissions assessment methodologies
- Setting appropriate carbon reduction targets
- Determining baselines against which to assess carbon reductions
- Establishing metrics (e.g. key performance indicators – KPIs) for credible carbon emissions monitoring and reporting
- Integrating carbon management into procurement
- Continual improvement of carbon management and performance.

Institute of Environmental Management & Assessment Guide: Assessing Greenhouse Gas Emissions and Evaluating their Significance 2nd Edition (2022)

14.3.22. Whilst DMRB LA 114 remains the sole standard which the Scheme has been assessed against and reported in this ES, the Institute of Environmental Management and Assessment (IEMA) guidance has been used to assist, as it provides a complementary narrative to some elements of DMRB LA 114. IEMA

states that this guidance is to assist greenhouse gas practitioners with addressing greenhouse gas emissions assessment, mitigation and reporting in statutory and non-statutory EIA. It is a revision of the 2017 IEMA guidance on Assessing Greenhouse Gas Emissions and Evaluating their Significance.

IEMA Environmental Impact Assessment Guide to: Climate Change Resilience & Adaptation (2020)

- 14.3.23. This guide provides a framework for the effective consideration of climate change resilience and adaptation in the EIA process in line with the UK Town and Country Planning (EIA) Regulations (2017).
- 14.3.24. This guidance notes that environmental statements should provide clarity on whether climate resilience has been appropriately considered in the design and development of a scheme.
- 14.3.25. Environmental statements produced in line with this advice will:
- Be proportionate in their approach and not include superfluous assessment that does not address likely material issues and always make reference to climate change.
 - Provide a concise explanation of how a project's resilience to climate change was considered.
 - Set out clearly how effects related to climate change have been assessed.
 - Define significance of effects pragmatically, taking account of the knowledge base used in the impact assessment.

14.4. Consultation

- 14.4.1. An Environmental Scoping Report (**TR010066/APP/6.8**) was submitted to the Planning Inspectorate in June 2023. A Scoping Opinion (**TR010066/APP/6.9**), prepared by the Planning Inspectorate on behalf of the Secretary of State, was received in response to the Environmental Scoping Report. The Applicant's responses to the Scoping Opinion are contained in the Scoping Opinion Response, ES Appendix 4.1 (**TR010066/APP/6.3**).
- 14.4.2. Responses in relation to the statutory consultation undertaken are presented in the Consultation Report (**TR010066/APP/5.1**). Details of how the applicant has undertaken further engagement with statutory consultees is set out in the Consultation Report (**TR010066/APP/5.1**).
- 14.4.3. Within the Scoping Opinion (**TR010066/APP/6.9**), the Secretary of State agreed to scope out the Scheme's resilience to climate change during construction as the construction phase is over a short period of time and the effects of climate change occur over greater periods (ID 3.10.1 in ES Appendix 4.1 Scoping

Opinion Response (**TR010066/APP/6.3**)). Within the Scoping Opinion (**TR010066/APP/6.9**), the Secretary of State also agreed to scope out the Scheme's impacts from decommissioning, given that the Scheme would be used beyond the design life of the road infrastructure, and that it is unlikely that any future decommissioning would require an additional planning submission (ID 3.10.2 in ES Appendix 4.1 Scoping Opinion Response (**TR010066/APP/6.3**)). No other matters in relation to climate were scoped out of the assessment.

- 14.4.4. No ongoing consultation specific to climate has been undertaken beyond the request for the Scoping Opinion (**TR010066/APP/6.9**) for the Scheme.

14.5. Assessment methodology

Climate change (greenhouse gas) impact assessment

- 14.5.1. DMRB LA 114 (section 3.5.1) provides questions on the quantity of data in the required timescales to accurately assess greenhouse gas emissions. It is important to understand that availability of sufficient quantitative data is essential to assess the quantitative impact of greenhouse gas emissions on climate. Section 5 of Assessing Greenhouse Gas Emissions and Evaluating their Significance guidance from Institute of Environmental Management and Assessment (IEMA) provides information on different steps that need to be taken to make sure that a robust greenhouse gas emissions assessment has been conducted. According to IEMA guidance a robust greenhouse gas emissions assessment should follow a framework of five steps as follows:

- Define goal and scope of greenhouse gas emissions assessment
- Set study boundaries
- Decide upon assessment methodology
- Collect the necessary calculation data
- Calculate / determine the greenhouse gas emission inventory

- 14.5.2. The assessment has been conducted using data from the BoQ from the Scheme design. This includes: The first step is to define the goal and scope of greenhouse gas emissions assessment. Then, identification of the scope starts with understanding what is included and excluded from the study (boundary setting). This scoping exercise considers the inclusion of specific life cycle stages, whether there would be a consideration of greenhouse gas emissions from asset construction and operational emissions, etc. To undertake a thorough greenhouse gas emissions assessment, it is important to collect the necessary Bill of Quantities (BoQ) including estimates of the type and mass / volume of construction materials, transport of materials to the site and types of vehicles. Upon receipt of the BoQ, the quantification of greenhouse gas emissions is undertaken.

Assessment of construction impacts

- 14.5.3. The assessment of the construction effects on climate has been undertaken in accordance with DMRB LA 114 and includes assessment of the carbon emitted during construction using recognised calculation methodologies and tools outlined below:
- The National Highways Carbon Forecasting Tool October 2023 v2.5.1.
 - The Royal Institution of Chartered Surveyors (RICS) Whole Life Carbon Assessment (WLCA) for the Built Environment guidance and assumptions on the transport of materials to site.
 - Environmental Product Declarations (EPD) detailing the emissions for certain design aspects where appropriate for bespoke items.
- 14.5.4. The Woodland Carbon Code (WCC) for the soil carbon change unless an alternative site-specific methodology is determined.
- 14.5.5. The assessment has been conducted using data from the BoQ from the Scheme design. This includes:
- An assessment of emissions from estimates of all materials used.
 - An assessment of emissions associated with the transportation of materials to the site (including surplus material).
 - The assessment accounts for the emissions arising from waste materials produced, transportation, as well as construction / plant emissions from onsite activities. This is complemented with an assessment of carbon emissions that result from land-use change during construction.
 - The assessment of emissions mobilised by vegetation loss and soil disturbance during construction.

Assessment of operational impacts

- 14.5.6. The assessment of the operational effects on climate has been undertaken in accordance with PAS 2080:2023 which includes:
- Assessment of carbon emitted over the 60-year assessment period for the Scheme operation. This is presented through an appraisal of carbon for the Scheme opening year and forecast year to derive the change in emissions assessed in accordance with DMRB LA 114. The use of Web-based Transport Analysis Guidance (WebTAG) and the TAG database allows the definition of the study area, and assessment of change in carbon emissions, as defined by DMRB LA 114.
 - The Emissions Factors Toolkit (EFT) v12.0.1 (December 2023), published by the Department for Environment, Food and Rural Affairs (DEFRA), has been used to estimate the change in carbon emissions from end-users over the design life of the Scheme. The final output has been entered into the

TAG assessment sheet to obtain monetised numbers of carbon changes (Net Present Value of Carbon impacts (£)).

- For end user traffic emissions, a comparison of Do-Minimum (without the Scheme) and Do-Something (with the Scheme in place) scenarios has been undertaken based on the Scheme opening year (2028) and design year (2043). The total increase in vehicle carbon emissions associated with the Scheme (comparison of Do-Minimum and Do-Something scenarios) over the 60-year appraisal period have been estimated by calculating the difference in carbon emissions between Do-Minimum and Do-Something scenarios.
- Assessment of the emissions associated with electricity requirements for the operation of the Scheme. This utilises the data determined through design and publicly available emission factors for grid electricity from the Department for Energy Security & Net Zero (DESNZ).
- Assessment of the emissions associated with maintenance of the Scheme through the assessment period (for example resurfacing of pavement) has been undertaken in line with the methodology for construction detailed above. This includes a value analysis of these emissions to consider the projected improvements in investigating carbon reduction techniques for construction.
- As per paragraph 2.3 of DMRB LA 114, greenhouse gas emissions associated with decommissioning of the Scheme (i.e. modules C1 to C4 of the 'end of life' life cycle stage identified in PAS 2080:2023) are excluded from the assessment due to the length of the operational phase of the Scheme's assets (which is assumed to be greater than the 60-year appraisal period required by DMRB LA 114).

Significance of effects

- 14.5.7. The assessment of significance followed DMRB LA 114, the standard for a National Highways scheme on the strategic road network. Furthermore, as there is no universally agreed and adopted methodology to date, DMRB LA 114 provides a robust and clear methodology to be used in reporting likely significant effects for the purposes of the EIA Regulations.
- 14.5.8. DMRB LA 114 states that "*projects shall only report significant effects where increases in greenhouse gas emissions will have a material impact on the ability of Government to meet its carbon reduction targets*". It also notes that NPS NN states that "*It is very unlikely that the impact of a road project will, in isolation, affect the ability of Government to meet its carbon reduction plan targets*" and that in this context "*it is considered unlikely that projects will in isolation conclude significant effects on climate*".
- 14.5.9. The assessment includes a comparison of estimated carbon emissions arising from the Scheme with UK carbon budgets, and the associated reduction targets, in line with DMRB LA 114.

Assessment criteria

Value (sensitivity)

14.5.10. In line with DMRB LA 114, the following receptors have been identified:

- With regard to greenhouse gas emissions:
 - UKT carbon budgets (as a proxy for the global climate)
- With regard to the Scheme's vulnerability to climate change, key receptors are summarised as:
 - Receptors associated with the construction process (including the construction workforce, plant and machinery).
 - The assets and their operation, maintenance and refurbishment (e.g. road pavement surfaces, structures, earthworks and drainage, technology assets, soft estate).
 - End-users (e.g. members of the public or commercial operators using the Scheme).

14.5.11. In the absence of specific guidance in DMRB LA 114 on the valuation of receptors with regard to climate impacts, all receptors are considered to be of high value given the global importance of climate change and the potential for climate related impacts to adversely affect the health and safety of employees and road users.

Climate change resilience assessment

14.5.12. The climate change resilience assessment follows the methodology detailed in DMRB LA 114. This has been completed in liaison with the project Design Team and drawing on inputs from other EIA technical disciplines by considering the UKCP18 projections for the geographical location and timeframe of the Scheme (from construction through to operation).

14.5.13. DMRB LA 114 details how to assess the relevance of potential impacts during operations, significance criteria, evaluation of significance and when further design and mitigation measures are required. Due to the relatively short period anticipated for construction and considering the effects from climate change are felt over a much greater period, it is unlikely that climate change will be experienced during construction of the Scheme. As such this aspect has been scoped out for the construction period as set out above and as agreed by the Secretary of State in the Scoping Opinion, see ES Appendix 4.1 (Scoping Opinion Response) (**TR010066/APP/6.3**).

14.5.14. Where the climate change impact on project receptors is potentially significant, a risk assessment shall be undertaken. Once climate hazards have been identified as part of the detailed design stage, a risk assessment of those impacts on the

operational phase and their likelihood and consequences will be completed in accordance with the criteria in Table 14.4 and Table 14.5. A more accurate identification of potential climate hazards is only possible at detailed design stage.

- 14.5.15. Significance of effects will be determined in accordance with DMRB LA 114. This involves using a matrix comparing the likelihood of climate hazards, leading to an in-combination impact, with the consequence of in-combination impacts. The likelihood of climate hazards leading to an in-combination impact will be defined using an assessment of the regional climatic data, derived from the UKCP18 Climate Projections, combined with professional judgement. The consequence of in-combination effects will be based on the change to the significance of the effect of the Scheme on the resource or receptor for each relevant environmental discipline, taking into account the existing mitigation measures.

Table 14.4 Likelihood categories for climate hazards (Source: DMRB LA 114)

Likelihood	Description (probability and frequency of occurrence)
Very high	The event occurs multiple times during the lifetime of the project (60 years), for example approximately annually, typically 60 events.
High	The event occurs several times during the lifetime of the project (60 years), for example approximately once every five years, typically 12 events.
Medium	The event occurs limited times during the lifetime of the project (60 years), for example approximately once every 15 years, typically 4 events.
Low	The event occurs during the lifetime of the project (60 years), for example once in 60 years.
Very Low	The event can occur once during the lifetime of the project (60 years).

Table 14.5 Description of consequences for climate hazards (Source: DMRB LA 114)

Consequence of impact	Description
Very large adverse	Operation - national level (or greater) disruption to strategic route(s) lasting more than one week.
Large adverse	Operation - national level disruption to strategic route(s) lasting more than 1 day but less than 1 week or regional level disruption to strategic route(s) lasting more than 1 week.
Moderate adverse	Operation - regional level disruption to strategic route(s) lasting more than 1 day but less than 1 week.
Minor adverse	Operation - regional level disruption to strategic route(s) lasting less than 1 day.
Negligible	Operation - disruption to an isolated section of a strategic route lasting less than 1 day.

- 14.5.16. The significance of each effect is then evaluated through a matrix as detailed in Table 14.1. Any conclusions as to likely significant effects are based on and

incorporate confirmed design and mitigation measures (embedded mitigation), as described by LA 114. Any further design and mitigation measures are then incorporated, where practicable, to reduce the significance of effect to an acceptable level (not significant) and then residual effects will be determined.

Table 14.6 Significance matrix

		Magnitude of Impact (degree of change)				
		Very low	Low	Medium	High	Very high
Measure of consequence	Very large	NS	S	S	S	S
	Large	NS	NS	S	S	S
	Moderate	NS	NS	S	S	S
	Minor	NS	NS	NS	NS	NS
	Negligible	NS	NS	NS	NS	NS

NS = Not significant; S = Significant

14.6. Assessment assumption and limitations

14.6.1. The assessment has been based on the Scheme description presented in ES Chapter 2 (The Scheme) (**TR010066/APP/6.1**) and the design presented on the Works Plans (**TR010066/APP/2.3**) assuming a reasonable worst-case basis afforded by the limits of deviation (see Section 2.5 of ES Chapter 2 (The Scheme) (**TR010066/APP/6.1**)). It is assumed that in the instance of any changes to the design within the vertical and horizontal limits of deviation, mitigation measures would still be provided and would function as described in this Chapter and as such there would be no change to the assessment of significant effects.

Climate change (greenhouse gas) impact assessment

14.6.2. The assessment of construction phase greenhouse gas emissions provided within this Chapter is based on the preliminary Scheme design for the Scheme. The construction greenhouse gas emissions appraisal was based, in part, on assumptions and professional judgement due to limited data availability for certain elements, which are typically unknown at this stage of a scheme. A number of assumptions, therefore, have been made within the assessment using professional judgement, relevant guidance and experience gained from other schemes. These assumptions, which in many cases were worst case, are considered unlikely to have had a material influence on the resulting magnitude of estimated greenhouse gas emissions. The transport of material to site was calculated using the Royal Institution of Chartered Surveyors (RICS) Whole Life Carbon Assessment (WLCA) for the Built Environment guidance and assumptions. The RICS standard recommends applying 15% contingency factor

to construction carbon emissions to account for the uncertainty associated with the data within Bill of Materials (BoM) when the Scheme is at early stages.

- 14.6.3. The National Highways Carbon Forecasting Tool October 2023 (v2.5.1) estimates carbon emissions associated with plant processes using direct fuel usage entered by the contractor during the construction stage. Due to uncertainty regarding construction fuel use at this stage, plant emissions have only been included for site clearance, earthworks and drainage. Usage of plant fuel to calculate plant carbon emissions for all items will be confirmed at the detailed design stage.
- 14.6.4. Traffic data forecasts are based on multiple assumptions in accordance with DMRB requirements and therefore the carbon emissions associated with vehicular end-users are estimates and subject to change due to changing behaviours of those using the road into the future.
- 14.6.5. The operational assessment is based upon the traffic data derived from a traffic model for the Scheme, as detailed in the Transport Assessment (TR100066/APP/7.3). The parameters of this model are detailed within Section 4 of the Transport Assessment (TR100066/APP/7.3). In addition, the TAG assessment uses the future projections of vehicle fuel efficiency and split of vehicles by fuel type detailed in the TAG data book.

Climate change resilience assessment

- 14.6.6. Information on the climate baseline and future projections are based on accessible available information from third parties, including the historical meteorological variables recorded by the Met Office and the UK Climate Projections (UKCP18) also developed by the Met Office.
- 14.6.7. DMRB LA 114 states that climate assessments should use the H++ climate scenarios to test the sensitivity of vulnerable safety-critical features, to ensure that such features would not be affected by more radical changes to the climate beyond that projected in the latest set of UK Climate Projections. The H++ scenarios cover heat waves, cold snaps, low and high rainfall, droughts, floods and windstorms. However, of these climate related events, the greatest risks to safety critical features (e.g. structures) are considered likely to be those associated with flooding.
- 14.6.8. The H++ scenarios were developed using a set of climate change projections which have since been superseded (i.e. UKCP09); however, the Met Office does not propose to update these scenarios using UKCP18 (Met Office, 2018a). Following the publication of updated guidance on climate change allowances,

the H++ scenarios are no longer used to inform peak river flow allowances on highway schemes.

- 14.6.9. Climate projections are not predictions or forecasts but simulations of potential scenarios of future climate, under a range of hypothetical emissions scenarios and assumptions. Therefore, the results from running the climate models cannot be treated as exact or factual, but projected ranges of potential scenarios. They represent internally consistent representations of how the climate may evolve in response to a range of potential forcing scenarios, and their reliability varies between climate variables. Scenarios exclude outlying surprise or disaster scenarios in the literature, and any scenario necessarily includes subjective elements and is open to various interpretations. Generally global projections are more certain than regional, and temperature projections are more certain than those for precipitation. Furthermore, the degree of uncertainty associated with all climate change projections increases for projections further into the future.
- 14.6.10. Accordingly, any further research, analysis or decision-making should take account of the nature of the data sources and climate projections and should consider the range of literature, additional observational data, evidence and research available, and any recent developments in these.

14.7. Study area

- 14.7.1. Schedule 4 of the EIA Regulations requires that an ES describes the likely significant effects of the Scheme on the environment resulting from (among other aspects) the:
- Impact of the Scheme on climate (greenhouse gas emissions)
 - Vulnerability of the Scheme to climate change (adaptation)
- 14.7.2. These two aspects require definition of consideration of differing study methodologies as set out below.

Climate change (greenhouse gas) impact assessment

- 14.7.3. The assessment of effects on climate considers the extent to which carbon emissions resulting from the Scheme may impact the global climate and contribute towards climate change.
- 14.7.4. For construction and operational maintenance, the study area comprise greenhouse gas emissions associated with project construction related activities/materials and their associated transport.
- 14.7.5. For operational road user greenhouse gas emissions, the study area consists of the affected road network (ARN) defined for road user carbon (vehicle

emissions) in DMRB LA 105 Air Quality, which was derived from the transport model referred to in the Transport Assessment (**TR100066/APP/7.3**).

14.7.6. In accordance with DMRB LA 114, the sources and life cycle stages are summarised in Table 14.7 below.

Table 14.7 Sources and lifecycle stages for the Scheme carbon emissions (Source: DMRB LA 114)

Main stage of project life cycle	Sub-stage of life cycle	Potential sources of greenhouse gas emissions (not exhaustive)	Examples of activity data
Construction stage	Products and materials (A1-3)	Use of materials for temporary and permanent construction activities	Material quantities
	Transport to works site (A4)	The transportation of materials to the Scheme site, e.g. by HGV	Assumed distances of materials from suppliers to site
	Construction and installation processes (A5)	Construction plant use	Fuel / electricity consumption of machinery
Operation stage (to extend 60 years in line with appraisal period)	Operational energy use (B6)	Lighting emissions	Lighting energy in kWh
	User utilisation of infrastructure (B8)	Vehicles using the infrastructure	Traffic data by vehicle type

Climate change resilience assessment

14.7.7. The resilience of the Scheme to climate change relates to the effects that climate change may have on the Scheme such as increased risk and severity of flooding, rainfall events and other extreme weather conditions. Assessing the resilience of the Scheme to climate change is fundamentally different to the rest of the assessment, as it assesses the impact of an external event (climate change) on the Scheme, where the receptors are the elements of the Scheme. The study area has therefore been based on the Order Limits including the satellite compound and any temporary land take required. The Brinklow Road main compound is outside the Order Limits and falls under a separate planning agreement (refer to ES Chapter 2 (The Scheme) (**TR010066/APP/6.1**). The Order Limits are set out in ES Figure 2.1 (Scheme Location) (**TR010066/APP/6.1**).

14.8. Baseline conditions

Climate change (greenhouse gas) impact assessment

- 14.8.1. The following baseline information is based on national and county-wide data as carbon emissions cannot be assessed at a local receptor level, and once they are emitted, they are not limited to geographic boundaries.
- 14.8.2. In 2024, the UK Government published the 2022 UK Greenhouse Gas Emissions Final Figures ([Final UK greenhouse gas emissions national statistics: 1990 to 2022 - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2022)). UK net emissions were estimated at 406MtCO_{2e}, a decrease of 3.5% from the 2021 figure of 421MtCO_{2e}, and 9.3% lower when compared to 2019, the most recent pre-Covid-19 pandemic year. During 2022, 28% of UK carbon emissions were from the transport sector which is a 10% increase in comparison to 2020. It must be noted that the Covid-19 pandemic and resulting travel restrictions is likely to have had a significant impact on carbon emissions (particularly those of the transport sector) throughout the UK over 2019 and 2020 and the rebound is therefore considered to be the primary reason for this increase.
- 14.8.3. According to the Sixth Carbon Budget (Climate Change Committee (CCC), 2020), for 2018, carbon emissions from manufacturing and construction in the UK were estimated at 66 MtCO₂. Although the data accounts for manufacturing in addition to construction, this gives the best indication of the proportion of UK emissions associated with construction. Data is not available for the UK construction sector alone, but the World Green Building Council estimated that building materials and construction were responsible for approximately 11% of global energy related greenhouse gas emissions in 2018.
- 14.8.4. The projections from the Department for Energy Security and Net Zero show a decline in total emissions to 2040 (emissions are projected to fall by 21% from 2022 levels). In 2018, 97% of transport final energy consumption was from oil-based fossil fuels, but by 2040 this is projected to fall to 89% due to an increase in electric vehicles and increasing biofuels use.
- 14.8.5. The UK Government, as part of the Climate Change Act 2008, has set legally binding carbon budgets capping the amount of carbon that can be emitted in the UK over a five-year period, as shown in Table 14.8.

Table 14.8 UK Government carbon budgets

Carbon budget	Carbon budget level	Reduction below 1990 levels
Fourth Carbon Budget (2023-2027)	1,950MtCO _{2e}	51% by 2025
Fifth Carbon Budget (2028-2032)	1,725MtCO _{2e}	57% by 2030
Sixth Carbon Budget (2033-2037)	965MtCO _{2e}	78% by 2035

Carbon budget	Carbon budget level	Reduction below 1990 levels
Seventh to 16 th Carbon Budget	Not set yet	-

- 14.8.6. According to Department for Energy Security & Net Zero (DESNZ), the projections show shortfalls for the Fourth Carbon Budget and Fifth Carbon Budget of 188 MtCO₂e and 253 MtCO₂e, respectively. The projections take account of policies that have been implemented, adopted or planned and where the policy design is sufficiently advanced to allow assessment of quality impacts. Meanwhile, the CCC has stated that emissions will need to fall more rapidly than these targets. As such an ambitious Sixth Carbon Budget has been proposed by the CCC and accepted by the UK Government to allow the UK to meet net-zero carbon by 2050, with a commitment to a reduction of almost 80% by 2035 compared to 1990 levels.
- 14.8.7. The CCC has also determined a balanced net-zero pathway for construction and manufacturing that includes a reduction of carbon emission from those sectors of 43% by 2030, 75% by 2035 and 90% by 2040 to achieve the 97% reduction by 2050. This pathway considers a proportion of the reduction will come from improved resource efficiency in production and material substitution. Therefore, significant effort is required to ensure that all contributing emissions are reduced as far as possible through the design, construction, and operation of all schemes.

Climate change resilience assessment

- 14.8.8. The resilience of the Scheme to climate change considers an existing baseline with current climate conditions and how it can withstand the adverse effects of climate change in the future.
- 14.8.9. The Flood Risk Assessment (ES Appendix 13.1 (**TR010066/APP/6.3**)) has been undertaken to identify and assess the risks of all forms of flooding and coastal erosion to and from the project and demonstrated how these flood risks will be managed, taking climate change into account. The result of this assessment is presented in ES Chapter 13 (Road Drainage and the Water Environment) (**TR010066/APP/6.1**).
- 14.8.10. A current climate baseline for the wider region has been compiled using Met Office (2016) regional climate data. High level climate observations over a 30-year averaging period (1981-2010) are presented in Table 14.9 for West Midlands, which comprises Birmingham, Coventry, Dudley, Sandwell, Solihull, Walsall and Wolverhampton according to Midlands: climate (Met Office 2016). This information has been used as a baseline against which, the potential vulnerability of the Scheme, when subjected to the climate change projected by

the Met Office, is determined. Historical events as a result of weather patterns and extreme weather events, i.e., landslides after heavy rainfall, should be identified to provide an indication of past vulnerability.

Table 14.9 Historic climate baseline for West Midlands (1981-2010)

Climate variables	Climate observations
Temperature	Mean daily minimum temperatures can range from 0°C to 1.5°C in winter, whilst summer daily maximum temperatures can exceed 22°C.
Rainfall	Rainfall is generally well-distributed through the year, but the wettest month varies across the region. In the wetter upland areas of the north and west, there is a pronounced winter maximum when the Atlantic depressions are at their most vigorous. Over much of the Midlands, the number of days with rainfall totals of 1mm or more ('wet days') tends to follow a pattern similar to the monthly rainfall totals. In the higher parts of the west and north in winter (December - February), 40 to 45 days is the norm but this decreases to near 30 days in summer (June - August).
Wind	The Midlands area is one of the more sheltered parts of the UK, the windiest areas being in western and northern Britain, closer to the Atlantic. The strongest winds are associated with the passage of deep areas of low pressure close to or across the UK. The frequency and strength of these depressions is greatest in the winter half of the year, especially from December to February, and this is when mean speeds and gusts (short duration peak values) are strongest.
Air Frost	The average number of days with air frost in the Midlands varies from about 40 days per year in the lower Severn valley to over 60 days per year in the Peak District and sheltered areas of the Welsh Marches. Ground frost occurs on average on about 100 to 125 days per year, with a similar distribution to air frost.

Future baseline

- 14.8.11. The future baseline is obtained from the UK Climate Projections (UKCP19) developed by the Met Office which include regional climate projection data, for which the Scheme is included in the West Midlands region.
- 14.8.12. The UKCP18, published November 2018 provide regional climate projection information within the West Midlands Administrative Region (where the Scheme is located). The West Midlands region is predicted to experience changes in temperature, rainfall, and increase in frequency of extreme weather events because of climate change. These changes are predicted to occur under all emissions scenarios (low, medium and high levels of carbon emissions), which are incorporated into the climate change models used by the Intergovernmental Panel on Climate Change (IPCC). The general trend for the region is warmer, drier summers and milder, wetter winters.
- 14.8.13. Under the highest emissions scenario (RCP8.5) for the 2080s (2080-2099), estimated changes in climatic conditions are as outlined in Table 14.10.

Table 14.10 Future climate projections for Midlands (2080s; RCP8.5)

Climate variables	Climate observations
Temperature	The average annual temperature modelled to occur within 2080s, under the RCP8.5 scenario at the 50th percentile, is an increase of approximately 4-5°C. Summer temperature is projected to increase by 5-6°C under the central estimate, which represents 'as likely as not' probability of change (50th percentile). Average winter temperature is estimated to increase by 3-4°C (50th percentile).
Rainfall	The average annual rainfall rate predicted to occur between 2080 and 2099, under the RCP8.5 scenario at the 50th percentile, is an increase in precipitation anomaly between 0 and 10%. The average summer rainfall rate is projected to decrease by 30-40%, whereas the average winter rainfall rate is estimated to increase by 20-30% (in the 50th percentile or central estimate for both).

14.9. Potential impacts (construction and operation)

Climate change (greenhouse gas) impact assessment

- 14.9.1. The main impact on the Scheme would be the release of carbon emissions which would contribute to the cumulative impact carbon emissions are having on climate change.
- 14.9.2. The following section presents the results of the carbon emissions assessment associated with the Scheme. It also addresses the Scheme's impacts on climate, and its vulnerability climate change; including how the Scheme may affect the ability of the UK Government to meet its carbon reduction budgets.

Construction

- 14.9.3. Embodied carbon emissions from the construction materials for the Scheme are the main contributor to overall carbon emissions during construction. Additional emissions arise from the direct use of construction plant and transport of materials to the site from source and from site to disposal locations.
- 14.9.4. A carbon assessment using the National Highways Carbon Forecasting Tool (v2.5.1 published in October 2023) has estimated emissions of approximately 16,165 tCO₂e in association with the Scheme construction. These are presented in Table 14.11 below.

Table 14.11 Emissions associated with construction

Life Cycle Stage	Total Emissions (tCO ₂ e)
Product Stage (Modules A1-A3)	8,630
Construction Stage - Transport (Module A4)	2,837
Construction Stage – Construction and Installation Process (Module A5)	1726
Total	12,193

Operation

- 14.9.5. The Highways England Carbon Forecasting Tool (v2.5.1) predicts emissions associated with operational energy for the Scheme to be approximately 0.32 tCO₂e per annum, based on the annual kWh electricity demand of lighting columns, i.e., 18.94 tCO₂e over the 60-year appraisal period.
- 14.9.6. For end user traffic emissions, the estimated Do-Minimum emissions total over the 60-year appraisal period is 43,880,100 tCO₂e, the corresponding Do-Something emissions total is 44,241,726 tCO₂e. Therefore, the total increase in vehicle carbon emissions associated with the Scheme (comparison of Do Minimum and Do Something scenarios) over the 60-year appraisal period (2028 to 2087) is estimated to be 361,626 tCO₂e.

Climate change resilience

- 14.9.7. The climate of the study area is projected to change significantly over the lifetime of the scheme. Present day extreme weather events are increasing in frequency and there is a risk that the scheme may be affected during construction and operation. Where construction coincides with extreme weather event(s) such as droughts or storms, there may potentially be further construction impacts.

Construction

- 14.9.8. Climate events and potential associated impacts on the Scheme during construction are presented in Table 14.12 below.

Table 14.12 Climate events and anticipated impacts during construction

Climate Event	Impact
Changes to future precipitation regime – including increased winter precipitation	<ul style="list-style-type: none"> Increasing risk to earthworks stability due to both increased precipitation or drought. Damage to construction site and equipment if ground stability compromised due to becoming waterlogged.
Increased yearly average temperature - including increased summer temperatures	<ul style="list-style-type: none"> Safer driving conditions in winter if fewer frost and ice days. Risk to workforce in extreme or prolonged heat. Damage to plant and machinery in adversely hot temperatures.
Extreme weather events	<ul style="list-style-type: none"> Risk to workforce, plant, and machinery in extreme or prolonged weather events, including heat, flooding, and high winds.

Operation

- 14.9.9. Climate events and potential associated impacts on the Scheme during operation are presented in Table 14.13 below.

Table 14.13 Climate events and anticipated impacts during operation

Climate Event	Impact
Changes to future precipitation regime – including increased winter precipitation	<ul style="list-style-type: none"> Pavements are at risk of premature failure due to increase in sub-surface moisture. Structures are at a greater risk of joint, bearing, or surface failure. Drainage expected to be affected by increased precipitation including standing water, build-up of particulates in road surface, and flood risk. Earthworks stability at significant risk. Maintenance requirement increased due to improvements to growing conditions of vegetation. Mitigation planting may be affected by changes in precipitation.
Increased yearly average temperature - including increased summer temperatures	<ul style="list-style-type: none"> Structures are at a greater risk of joint, bearing, or surface failure due to increased heat. Road markings may experience accelerated weathering. Electronic equipment experiencing temperatures higher than tolerance may experience failure. Maintenance requirement increased due to improvements to growing conditions of vegetation. Mitigation planting may be affected by increased risk of disease.
Extreme weather events	<ul style="list-style-type: none"> Signs and lightweight structures may be affected due to frequency of extreme wind events. Maintenance may be affected due to safety concerns.

14.10. Design, mitigation and enhancement measures

Design

14.10.1. The development of the Scheme design has been an iterative process. The environment team has worked in close collaboration with the infrastructure design team to avoid or reduce environmental impacts through the Scheme design. This is referred to as embedded (or design) mitigation. The principles of the design and mitigation hierarchy outlined in DMRB LA 104 Environmental Assessment and Monitoring have been followed. The first principle being to avoid potential adverse effects, if at all feasible, before seeking to minimise or mitigate for any unavoidable impacts. Embedded mitigation for the Scheme are reported in ES Chapter 2 (The Scheme) (**TR010066/APP/6.1**). Scheme design principles adopted to avoid or prevent adverse environmental effects are set out within the Scheme Design Report (**TR010066/APP/7.4**). This includes general principles and specific commitments that will inform the detailed design of the scheme. ES Chapter 3 (Assessment of Alternatives) (**TR010066/APP/6.1**) details the design alternatives that have been considered, including the environmental factors which have influenced the decision-making.

Mitigation

Climate change (greenhouse gas) impact assessment

- 14.10.2. As stated in Section 14.3.6, The 'Net Zero Highways' plan (National Highways, 2021) sets out National Highways' programme for achieving net zero greenhouse gas emissions for the SRN by 2050.
- 14.10.3. Within the plan, a number of key targets have been set to achieve each of these commitments (from 2022 onwards). Many of these targets involve research and / or the development of future policies and procedures as National Highways transition towards achieving net zero, the outcomes of which would inform the design, development and operation of the Scheme going forwards (where applicable)
- 14.10.4. All construction and operational activities and materials associated with the Scheme will result in carbon emissions contributing to a negative impact on the climate. Residual effects will arise as it is not currently feasible to fully eliminate emissions resulting from the production of road building materials, construction activities, as well as energy use and end-user traffic emissions during Scheme operation.
- 14.10.5. To reduce carbon emissions, the following measures are applied in accordance with the carbon emissions reduction hierarchy of PAS 2080:2023 (Commitment RD1 of the Register of Environmental Actions and Commitments (REAC), Appendix A of the First Iteration EMP (**TR010066/APP/6.5**)):
- **Avoid:** the design seeks to increase the potential for re-using and / or refurbishing existing assets to reduce the extent of new construction required or explore alternative lower carbon options to deliver the project objectives.
 - **Switch:** apply low carbon solutions (including technologies, materials and products) to reduce resource consumption during the construction, operation, user's use of the project, and at end-of-life; and construct efficiently: use techniques that reduce resource consumption over the lifecycle of the project.
 - **Improve:** after addressing steps 1 and 2, projects will identify, assess and integrate measures to further reduce carbon through on-site or off-site offsetting or sequestration.
- 14.10.6. The Outline Carbon Management Plan, Appendix B.8 of the First Iteration EMP (**TR010066/APP/6.5**), outlines the framework for managing and reducing the greenhouse gas emissions from the Scheme. This document outlines the project-specific context as well as the carbon quantification methodology, carbon target review and the development of carbon mitigation strategies, of which all

are required to be implemented from the outset of project development / initiation. It outlines the requirements for monitoring and reporting carbon for all construction and operational activities and materials associated with the Scheme.

14.10.7. DMRB LA 104 carbon reduction hierarchy is applied as following:

- **Avoidance and prevention:** design and mitigation measures to prevent the effect (e.g. alternative design options or avoidance of environmentally sensitive sites).
- **Reduction:** where avoidance is not possible, then mitigation is used to lessen the magnitude or significance of effects.
- **Remediation:** where it is not possible to avoid or reduce a significant adverse effect, these are measures to offset the effect.

14.10.8. A number of opportunities for carbon savings and mitigation measures have been discussed with the Design Team and proposed in order to reduce the impact of the Scheme on climate which are listed below:

Design measures (Preliminary design stage)

14.10.9. Within the structures design it has been determined that there is no need for alternative field access and instead the existing Hungerley Hall Farm accommodation overbridge will be retained. This will result in reducing time, demolition, and material costs which will contribute to an overall carbon saving. The design items are discussed in detail in ES Chapter 2 (The Scheme) (TR010066/APP/6.1). Carbon, alongside the other environmental topics, was considered during the optioneering stages to reduce carbon emissions as detailed in ES Chapter 3 (Assessment of Alternatives) (TR010066/APP/6.1).

14.10.10. During earthworks there would be efforts to maximise the use of site won materials (Commitment MA1 of the REAC, Appendix A of the First Iteration EMP (TR010066/APP/6.5)). The re-use of plainings as bound material on site is planned as well. Both of these opportunities would result in reduced transport requirements and resulting emissions, as a reduced transport distance will mean less fuel will be consumed in transport vehicles. The use of existing materials instead of importing virgin materials also reduces emissions associated with the extraction of raw materials, transport to manufacture site, and manufacture of raw materials to finished product (A1-A3).

Detailed design mitigation opportunities Structures

14.10.11. Within the structures design there is also an opportunity to use pre-cast concrete step barriers (CSB) rather than slip formed. As part of the detailed

design process, the Applicant and its contractors will investigate the feasibility of implementing CSB in the design (Commitment C1 of the REAC, Appendix A of the First Iteration EMP (**TR010066/APP/6.5**)). Precast concrete can help reduce carbon emissions thanks to a better optimised process leading to less waste and bulk production.

Earthworks

14.10.12. In earthworks cut / fill balance there is an opportunity for horizontal and vertical alignments to be optimised for cut / fill balance. The retaining walls have been removed from the link road. The retaining walls on the slip road are to be further reviewed at detailed design (Commitment C1 of the REAC, Appendix A of the First Iteration EMP (**TR010066/APP/6.5**)). Imported fill generally leads to high carbon emissions associated with transport (large quantities of material involved), and with the extraction and treatment of raw material. Optimising the earthworks cut / fill balance can prevent importing virgin material and therefore lead to great carbon savings.

14.10.13. During earthworks there is an opportunity for hydrogenated vegetable oil (HVO) to be considered as an alternative low emission plant. Electric or hydrogen powered plant are also to be considered (Commitment C1 of the REAC, Appendix A of the First Iteration EMP (**TR010066/APP/6.5**)). Fuel combustion is highly emissive of carbon, alternative options such as HVO or electric (powered by renewable energy) and hydrogen powered plant are considered to have a much lower carbon impact and therefore can lead to generous carbon savings.

Drainage

14.10.14. Within pipe lining for drainage there is an opportunity to use the existing network, where possible. CCTV information is under review to investigate any defects and current conditions to assess the viability of replacing the existing faulty drainage with digital or innovative technology (Commitment C1 of the REAC, Appendix A of the First Iteration EMP (**TR010066/APP/6.5**)). This will minimise the amount of required construction and materials, reducing associated emissions.

Pavements

14.10.15. In pavements there are efforts to make sure that best practice construction processes and materials are applied to designs, so the end result is a durable pavement structure with a maximised life span (Commitment C1 of the REAC, Appendix A of the First Iteration EMP (**TR010066/APP/6.5**)). Improvements in lifespan lengthens the time between repairs and / or replacement, this reduces both cost and carbon emissions.

- 14.10.16. For pavement asphalt mixtures the Scheme is looking to use recycled mixes.
- 14.10.17. In pavements an opportunity to use recycled aggregate is being considered. Recycled materials generally have a lower carbon impact than their traditional equivalent using virgin materials.
- 14.10.18. In pavement narrow widenings low carbon concrete will be investigated and used where possible. Low carbon concrete are usually produced with a reduced amount of cement, using alternatives such as Ground Granulated Blast-furnace Slag (GGBS) or Fly Ash, which is a less carbon intensive material. The specific mix and feasibility will be determined at a later stage.
- 14.10.19. In pavements there is an opportunity to reduce the moisture content of aggregate feedstocks to reduce the drying energy demand during asphalt production. Energy consumption is directly linked to carbon emissions, therefore reducing demand at the source (A1-A3) will lead to a better embodied carbon performance of materials. This should be investigated with any suppliers for the Scheme once they are identified.
- 14.10.20. In pavements there is an opportunity to use longer-life asphalt materials (using a polymer modified binder (PMB) and / or longer life binders, and bio-binders). Improvements in lifespan lengthens the time between repairs and / or replacement, this reduces both cost and carbon emissions.

Site

- 14.10.21. Collaboration and further investigation will be required for some specific plant once suppliers have been identified. This is the case for asphalt plant for example, where alternative fuels for heating and drying can be considered. Carbon benefits in using alternative energy sources for plant has been demonstrated above.

Climate change resilience assessment

- 14.10.22. A number of general mitigation and adaptation measures will be considered to address potential risks, many of which have been identified by other technical assessments and the Scheme design. The assessment takes into account the existing resilience measures for each climate risk either already in place or in development for infrastructure and assets.
- 14.10.23. During the preliminary design stage, the Design Team have been briefed on projected climate changes (Table 14.10) to ensure that the Scheme will be accordingly resilient by design.

14.10.24. The potential vulnerability of the Scheme to climate change has been assessed through iterative consultation between the Design Team and the technical authors of this climate assessment Chapter. Specific assets assessed are shown in Table 14.18 with design considerations detailed within the individual ES aspect chapters (e.g., ES Chapter 13 (Road Drainage and the Water Environment) (**TR010066/APP/6.1**)), although it is noted that no aspect of the Scheme is considered to be vulnerable to projected climate change over the appraisal period.

Enhancement measures

14.10.25. No enhancement measures have been identified for climate. Enhancement measures for resilience of the Scheme to climate change will be considered further as part of the detailed design development.

14.11. Assessment of likely significant effects (construction and operation)

Climate change (greenhouse gas) impact assessment

- 14.11.1. As noted in DMRB LA 114 referencing the NPS NN, it is very unlikely that the impact of any road project will, in isolation, affect the ability of the UK Government to meet its carbon reduction plan targets; therefore, it is considered unlikely that any project in isolation would conclude significant effects in terms of climate. Cumulative effects of the Scheme are considered further in ES Chapter 15 (Combined and Cumulative Effects) (**TR010066/APP/6.1**).
- 14.11.2. However, in line with the UK Government carbon reduction plan, the Scheme will seek to reduce carbon emissions as far as practicable to contribute to the UK's net reduction in carbon emissions and maximise the potential for reducing carbon emissions.
- 14.11.3. In accordance with DMRB LA 114, the assessment of effects of the Scheme does not preclude efforts to minimise carbon throughout the detailed design and construction phases. Several measures have been adopted as part of the design of the Scheme to reduce the carbon emissions as stated above. The UK government announcement on ending the sales of new petrol and diesel vehicles by 2035 will further reduce the Scheme's end user carbon emissions.
- 14.11.4. For both construction and operational effects on climate, it is unlikely that the Scheme will result in greenhouse gas emissions that would be defined as significant considering the greenhouse gas emissions from the Scheme are unlikely to have a material impact on the Government achieving its carbon targets. That said, in line with the UK Government's Carbon Reduction Plan, the Scheme has sought to reduce greenhouse gas emissions as far as practicable

to contribute to the UK's net reduction in greenhouse gas emissions and maximise the potential for reducing greenhouse gas emissions.

Benchmarking

- 14.11.5. Paragraph 3.21 of DMRB LA 114 requires that the performance of a scheme should be benchmarked by comparing estimated greenhouse gas emissions with those associated with other highway schemes. As such, Table 14.15 compares estimated construction phase greenhouse gas emissions (including added contingency) associated with the Scheme against a selection of other highway schemes for which comparable data were readily available.
- 14.11.6. In order to enable a more direct comparison, and as per paragraph 3.21.1 of DMRB LA 114, estimated construction phase greenhouse gas emissions for each scheme have also been normalised by dividing total construction phase greenhouse gas emissions by the length of the scheme. It should be noted, however, that factors other than length will influence the magnitude of construction phase greenhouse gas emissions associated with any particular scheme (e.g. the number of lanes, junctions and structures).
- 14.11.7. The greenhouse gas emissions associated with changes in land use and forestry have been excluded from Table 14.15 in order to provide a like-for-like comparison as greenhouse gas emissions have not been estimated for this emission source for the majority of the other schemes considered.
- 14.11.8. A similar comparison has not been undertaken for operational phase greenhouse gas emissions as operational phase greenhouse gas emissions are dominated by road user greenhouse gas emissions, changes in which will be specific to each scheme based on a number of factors (not just scheme length), including not least the schemes' geographical location and existing levels of traffic flows and congestion.
- 14.11.9. The data presented in Table 14.15 indicates that the Scheme is estimated to result in much less normalised construction phase greenhouse gas emissions compared to other schemes.

Table 14.14 Comparison of Scheme's construction greenhouse gas emissions with other road schemes (tCO₂e)

Sub-stage of Scheme life cycle	Element	Scheme and approximate scheme length							
		Scheme	M60	A12 Chelmsford to A120 Widening	M54 to M6 Link Road	A14 Cambridge to Huntingdon improvement	A57 Link Roads	A417 Missing Link	A428 Black Cat to Caxton Gibbet improvements
		3.67km	3.5km	24km	2.5km	37km	3.1km	5.5km	19km
Product stage; including raw material supply, transport and manufacture (A1–A3)	All	13,058	29,058	238,050	49,620	740,062	22,796	40,698	163,230
Construction process stage (A4–A5)	Employee commuting	807	2,745	5,784	2,420	210,278	371	2,668	4,430
	Transport of fuel	29	48	1,444	Not given	518	20		Not given
	Transport of materials		8,289	59,071	15,940	22,391	8,490		Included in product stage
	HGVs onsite	Included in above	Included in above	Included in above	Not given	2,792	Not given		Not given
	Onsite consumption of fuel, energy and water	Not given	15,962	63,838	4,250	5,110	7,273	20,818	45,210
	Waste treatment and transport	129	5,385	19,938	7,780	281	19		1,360
Construction phase total (excluding greenhouse gas emissions associated)		14,023	61,486	388,124	80,010	981,432	38,970	64,184	214,230

Sub-stage of Scheme life cycle	Element	Scheme and approximate scheme length							
		Scheme	M60	A12 Chelmsford to A120 Widening	M54 to M6 Link Road	A14 Cambridge to Huntingdon improvement	A57 Link Roads	A417 Missing Link	A428 Black Cat to Caxton Gibbet improvements
		3.67km	3.5km	24km	2.5km	37km	3.1km	5.5km	19km
with changes in road users, land use and forestry)									
Construction phase total (tCO2e per km)		3,821	17,568	16,172	32,004	26,525	12,571	11,670	11,275

Summary of assessment against carbon budgets

14.11.10. The total of the change in emissions as a result of the Scheme is presented in Table 14.15. This can be due to any changes in traffic flow, vehicle type, the distance that vehicle is travelled or other reasons. Any negative value in changes of emissions indicates a decrease in carbon emissions, whereas a positive value indicates an increase in emissions.

Table 14.15 Change in tCO₂e associated with the Scheme end user traffic emissions by carbon budget period (all figures shown are increases of the Do-something scenario compared to Do-minimum)

	Fifth (2028 to 2032)	Sixth (2033 to 2037)	Seventh to 16th (2038 to 2087)
Carbon budget (tCO₂e)	1,725,000,000	965,000,000	Not yet set
Change in traded emissions (tCO₂e)	+352	+373	+4,492
Change in non-traded emissions (tCO₂e)	+ 26,091	+ 28,178	+ 302,139

Note: Traded emissions are those covered by the EU Emission Trading System and non-traded emissions are the ones outside the EU Emission Trading System.

14.11.11. Construction and operational emissions predicted to result from the Scheme are presented in Table 14.16 against each relevant carbon budget period by comparing the ARN baseline (Do Minimum) emissions with those predicted to result from the Scheme (Do Something). Due to the nature of the design at the preliminary design stage and inherent uncertainty in precisely defining construction emissions, a 15% uplift contingency factor has been applied to construction emissions as per the RICS Professional Standard on Whole Life Carbon Assessment for the built environment.

Table 14.16 Potential impact of the Scheme on carbon emissions (including ARN) compared against relevant UK Government carbon budgets.

Project stage	Carbon emissions distributed per relevant carbon budget (tCO ₂ e)			Estimated total emissions over 60-year appraisal period (tCO ₂ e)
	Fifth (2028 to 2032)	Sixth (2033 to 2037)	Seventh to 16 th (2038 to 2087)	
Baseline (DM)	4,489,469	4,133,068	35,247,567	43,880,100
Construction (DS)	12,193	-	-	12,193
Operation (DS)	4,515,912	4,161,619	35,564,195	44,241,726
Total (DS)	4,528,105	4,161,619	35,564,195	44,257,891
Difference (DS-DM)	+38,637	+28,551	+306,632	+373,819

Note: The construction carbon value is representative of the National Highways Carbon Tool assessment including an uplift factor of 15% according to the RICS methodology to account for the uncertainty of preliminary design stage data. The operational carbon value is representative of estimated user utilisation

emissions for the ARN over the 60-year appraisal period. DM = Do Minimum, DS = Do Something. Operational energy is not shown on this table as not available.

14.11.12. Table 14.17 expands upon the previous table by including the net change in emissions as a percentage of UK carbon budgets. Existing carbon budgets (one to five) predate the net zero carbon target (by 2050) legislated in 2019. The sixth carbon budget published in June 2021, requires accelerated carbon reduction in the UK towards net zero carbon emissions. The net change in emissions from the Scheme has been calculated by comparing the baseline (Do Minimum) emissions with those predicted to result from the Scheme (Do-Something).

Table 14.17 Summary of the net change in emissions against relevant carbon budgets.

Project stage	Estimated total carbon emissions (tCO ₂ e) ('Do something' Scenario)	Net carbon emissions (tCO ₂ e) (Do something – Do minimum)			Net carbon emissions contribution to relevant carbon budgets (tCO ₂ e(%))		
		Fifth (2028 to 2032)	Sixth (2033 to 2037)	Seventh to 16 th (2038 to 2086)	Fifth (2028 to 2032)	Sixth (2033 to 2037)	Seventh to 16 th (2038 to 2086)
Construction	12,193	+12,193	-	-	<0.0001%	-	-
Operation	44,241,726	+26,444	+28,551	+306,632	<0.0001%	<0.0001%	-
Total	44,253,919	+38,637	+28,551	+306,632	<0.0001%	<0.0001%	-

Note: The construction carbon value is representative of the National Highways Carbon Tool assessment including an uplift factor of 15% according to the RICS methodology to account for the uncertainty of preliminary design stage data. The operational carbon value is representative of estimated user utilisation emissions over the 60-year appraisal period. Operational energy is not shown on this table as not available. It is not possible to assess the change as a % of the carbon budgets beyond 2037 as they have not been set.

14.11.13. The increase in carbon emissions resulting from the Scheme represents up to approximately 0.0003% of relevant carbon budgets over their respective periods.

14.11.14. Comparison between the increase in the Scheme emissions and published carbon budgets, following DMRB LA 114 guidance on determining significance, can only be undertaken for approximately 19% of the emissions increase. The remaining 81% of the increase in carbon emissions will occur after 2038 (the end of the last currently published UK carbon budget), however, there is the commitment to meet the Climate Change Act (2050 Target amendment) target of net zero emissions by 2050. It is expected that the remaining 81% of the increase in carbon emissions will be reduced due to the uptake of electric vehicles, with a further opportunity of increased use and improved public transport in the area. However, there is currently too much uncertainty to model this opportunity. DMRB LA 114 Note 1 and 2 of section 3.19 state that “[...] it is very unlikely that the impact of a road project will, in isolation, affect the ability of

Government to meet its carbon reduction plan targets. [...] it is considered unlikely that projects will in isolation conclude significant effects on climate". For both construction and operational effects on climate, **it is unlikely that the Scheme will result in greenhouse gas emissions that would be defined as significant** considering the greenhouse gas emissions from the Scheme are unlikely to have a material impact on the Government achieving its carbon targets.

Climate change resilience assessment

- 14.11.15. In the context of the vulnerability of the Scheme to climate change, projected climate change is not anticipated to have a significant effect.
- 14.11.16. Table 14.18 lists the key climate change effects that affect the Scheme, with corresponding likelihoods, significance of effect and whether specific mitigation is required. This list was provided to Design Teams for them to use their respective knowledge and expertise in assessing the vulnerability Scheme to climate change. Design Teams were also requested to consider any other potential effects beyond those listed in Table 14.18, although no further such effects were identified.

Table 14.18 Vulnerability of the Scheme assets to climate change - Summary of effects and mitigation.

Receptor	Life cycle asset aspect	Climate Event	Potential effect description	Likelihood category	Consequence of impact	Significance	Mitigation measures
Pavements	Foundations	Increases in winter precipitation	Increased sub-surface moisture content, decreasing foundation strength. Increases likelihood of foundation failure earlier than otherwise expected. An increase in replacement / maintenance is expected as a result.	Very low	Large adverse	Not significant	N/A
		Changes in moisture content as a result of decreases in summer rainfall combined with increases in winter rainfall	Will cause soil to expand and shrink, causing pavement layers to heave. Damage to road may lead to disruption and / or inaccessible network. Where soil shifts remain unnoticed, there will be an increased health and safety risk during operation.	Very low	Moderate adverse	Not significant	N/A
		Increased rainfall	Can lead to saturation of the road sub-base or other structural granular materials, causing loss of fine material and settlement and subsequent premature pavement failure.	Very low	Moderate adverse	Not significant	N/A
	Surface	Increased summer temperatures	Result in surface failure, e.g. warping of slabs, excessive movement at joints and difficulty in maintaining asphalt surface profile during compaction.	Low	Minor adverse	Not significant	N/A

Receptor	Life cycle asset aspect	Climate Event	Potential effect description	Likelihood category	Consequence of impact	Significance	Mitigation measures
		Increases in winter precipitation	Result in a build-up of particulates in the road surface, which compromises the surface's skid resistance as skid resistance decreases in flooded areas.	Medium	Minor adverse	Not significant	N/A
Structures (e.g. gantries, overbridges)	Above ground structures	Increased temperatures	Result in joint and bearing failure.	Very low	Large adverse	Not significant	N/A
		Increases in precipitation	Results in increased deterioration rates for joints and surfacing, requiring more frequent replacement and traffic disruption.	Low	Moderate adverse	Not significant	N/A
		Increased winter precipitation	Results in increased groundwater levels, causing ground movements and soil settlement.	Very low	Moderate adverse	Not significant	N/A
		Increased precipitation	Results in flooding and scouring around foundations.	Very low	Moderate adverse	Not significant	N/A
		Increases in temperature and more variable precipitation	Result in increased frequency of maintenance painting of structural steelwork.	Low	Minor adverse	Not significant	N/A
		Increases in wind speed and frequency of extreme wind events	Results in the failure of lighter structures by overturning.	Very low	Large adverse	Not significant	N/A
		Increased winter precipitation	Results in increased groundwater levels causing	Very low	Moderate adverse	Not significant	N/A

Receptor	Life cycle asset aspect	Climate Event	Potential effect description	Likelihood category	Consequence of impact	Significance	Mitigation measures
	Foundations and substructure		ground movements and soil settlement.				
		Increased precipitation	Results in flooding and scouring around foundations.	Very low	Moderate adverse	Not significant	N/A
Drainage	Drainage system	Increases in winter precipitation	Result in increased flood risk and the need for attenuation.	Medium	Minor Disruption	Not significant	Climate change has been considered in the drainage design in accordance with DMRB and current government guidance (ES Appendix 13.1 (Flood Risk Assessment) (TR010066/APP/6.3)
Geotechnics	Earthworks	Increased precipitation	Results in increased risk to the earthworks stability.	Low	Moderate adverse	Not significant	N/A
		Reductions in summer precipitation and increases in temperature	Reduces soil moisture, which demands a greater effort for compaction of soils.	Very low	Moderate adverse	Not significant	N/A
Signs and signals	Advance Direction Sign (ADS)	Increased wind speeds and frequency of extreme wind events	Will affect the stability of ADSs, which have a design life of 15 years (Highways England, 2011).	Very low	Moderate adverse	Not significant	N/A
	Road markings	Increases in precipitation and temperature	Affect road markings.	Low	Minor adverse	Not significant	N/A
Walking, cycling and	WCH routes	Increases in temperature and	Encourage a greater number of WCHs to use WCH facilities.	Medium	Beneficial – N/A	N/A	N/A

Receptor	Life cycle asset aspect	Climate Event	Potential effect description	Likelihood category	Consequence of impact	Significance	Mitigation measures
horse-riding (WCH) facilities		reductions in summer rainfall					
		Increases in winter rainfall and frequency of extreme wind events	Discourage WCHs from undertaking journeys using WCH facilities.	Low	Minor adverse	Not significant	N/A
Vehicle restraint systems	Safety barriers	More frequent extreme weather events and changes in temperature and precipitation	Result in an increased rate of deterioration of vehicle restraint systems.	Low	Moderate adverse	Not significant	N/A

14.12. Monitoring

Climate change (greenhouse gas) impact assessment

- 14.12.1. The Scheme will result in an increase in carbon emissions during construction and operation, albeit not considered to be significant. Monitoring of emissions associated with the construction of the Scheme will be undertaken as per National Highways requirements to meet their key performance indicator “Carbon dioxide equivalents (or CO₂e) in tonnes associated with the Supply Chain’s activities” (National Highways 2019). Quarterly carbon emission returns required during operation phase would be provided by the Principal Contractor in accordance with National Highways’ requirements using the National Highways’ Carbon emissions calculation tool (Commitment C2 of the REAC, Appendix A of the First Iteration EMP (**TR010066/APP/6.5**)).
- 14.12.2. Actual data provided for the greenhouse gas returns would be evaluated using National Highways carbon tool to inform any ongoing monitoring of carbon emissions and also feed back into future assessment of schemes during design development and through the DCO process.
- 14.12.3. The First Iteration EMP (**TR010066/APP/6.5**), sets out monitoring to be undertaken during the construction stage to so that the mitigation measures embedded in the Scheme design are implemented. During the construction phase of works a Second Iteration EMP will secure the monitoring requirements and procedures to reduce or eliminate impacts on the environment (Commitment G1 of the REAC, Appendix A of the First Iteration EMP (**TR010066/APP/6.5**)).
- 14.12.4. In line with DMRB LA 114 the operation of the Scheme is required to manage, maintain and monitor asset data to make sure the Scheme is operating as intended. Adaptive management would be employed during the operational period where it is necessary to adapt the asset management in response to climate impacts. Where appropriate, additional interventions would be determined and implemented. During detailed design a detailed monitoring plan would be determined in line with the requirements for the Scheme and the planned operational procedures (Commitment C2 of the REAC, Appendix A of the First Iteration EMP (**TR010066/APP/6.5**)).

Climate change resilience assessment

- 14.12.5. Climate change projections may potentially change prior to construction of the Scheme, therefore the vulnerability of the Scheme to such changes will be reviewed as and when updated projections become available. (Commitment C3 of the REAC, Appendix A of the First Iteration EMP (**TR010066/APP/6.5**)). This will be included within the Carbon Management Report that will be prepared at the end of each design stage to provide a baseline for monitor delivery of the

next stage, for example operation after construction stage, to continually strive for reduced carbon emissions. Details of the Carbon Management Report are included within the Outline Carbon Management Plan (Appendix B.8 of the First Iteration EMP (TR010066/APP/6.5)).

14.13. Conclusions

- 14.13.1. This assessment has considered the Scheme's effect on climate (i.e. increases in carbon emissions) as well as the potential vulnerability of the Scheme to climate change (i.e. the resilience of the Scheme assets to projected changes in climate).
- 14.13.2. A baseline assessment using the National Highways Carbon Forecasting Tool (v2.5.1) has been carried out as part of the development of the Scheme. This has allowed for the consideration of carbon throughout the design process, resulting in the development of a carbon baseline from which further reductions may be made as part of the detailed design stage and through opportunities during the construction phase.
- 14.13.3. The construction, operation and use of the Scheme is predicted to increase carbon emissions by approximately 377,791 tCO₂e over the appraisal period of 60 years (up to 2087). However, the contributions of the Scheme to the UK's carbon budget for the relevant carbon budget periods are not significant, less than 0.003% (including embedded mitigation within current design), and therefore it can be concluded that the greenhouse gas emissions impact of the Scheme would not have any material impact on the UK Government meeting its legally binding carbon reduction targets.
- 14.13.4. The vulnerability of Scheme assets to projected changes in climate during operation has been assessed, and the Scheme has been deemed resilient to the current projections. Therefore, no significant effects as a result of climate change are anticipated.

Acronyms

Acronym	Meaning
ADS	Advance Direction Sign
ARN	Affected Road Network
BoQ	Bill of Quantities
CCC	Climate Change Committee
DCO	Development Consent Order
DEFRA	Department for Environment, Food and Rural Affairs
DESNZ	Department for Energy Security & Net Zero
DFT	Department for Transport
DMRB	Design Manual for Roads and Bridges
EIA	Environmental Impact Assessment
EFT	Emissions Factors Toolkit
EPD	Environmental Product Declarations
GGBS	Ground Granulated Blast-furnace Slag
GHG	Greenhouse Gases
IPCC	Intergovernmental Panel on Climate Change
NPS NN	National Policy Statement for National Networks
NSIP	Nationally Significant Infrastructure Projects
RICS	Royal Institution of Chartered Surveyors
SoS	Secretary of State
TAG	Transport Analysis Guidance
UKCP18	UK Climate Projections 2018
WCC	Woodland Carbon Code
WCH	Walking Cycling Horse riding
WebTAG	Web-based Transport Analysis Guidance

Glossary

Glossary term	Definition
Access	The means by which to approach or enter land, property and assets.
Accessibility	The ability of users to access land, property, infrastructure, businesses and community facilities.
Affected road network	All roads that trigger the traffic screening criteria and adjoining roads within 200m
Agricultural land holdings	Land and associated infrastructure for the purpose of agricultural production, e.g. arable farming, dairy farming etc.
PAS 2080:2023	World's first standard for Carbon Management in Buildings and Infrastructure

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