M5 Junction 10 Improvements Scheme

Environmental Impact Assessment

Scoping Report

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Contents

Tables

Figures

Executive Summary

Gloucestershire faces significant challenges to achieve its vision for economic growth. A Joint Core Strategy (JCS), developed through a partnership between Gloucester City Council, Cheltenham Borough Council (CBC) and Tewkesbury Borough Council (TBC) presented the strategic development plan to show how the region will develop during the period up to 2031. This includes a shared spatial vision targeting new homes and jobs by 2041, through developments in strategic and safeguarded allocations in the West and North West of Cheltenham.

Cheltenham currently experiences significant congestion at peak times. The existing M5 Junction 10 only provides access and egress to and from the north on the M5, with no connectivity to the M5 southbound. This drives existing traffic across Cheltenham through various routes to access and leave the M5 from the south which significantly contributes to existing traffic flows in the town. To unlock the housing and job opportunities identified in the JCS, a highways network is needed that has the capacity to accommodate the increased traffic it will generate, within a sustainable transport context.

The objectives of the M5 Junction 10 Improvements Scheme (the Scheme) are to:

- Provide the transport connections and network capacity in west and north-west Cheltenham to facilitate the delivery of housing and economic development sites allocated or safeguarded in the JCS.
- Provide a transport network in the west and north-west Cheltenham area with the levels of service, safety and accessibility to meet current and future needs.
- Provide greater connectivity between the strategic road network (SRN) and the transport network in west and north-west Cheltenham.
- Provide a more integrated transport network by enabling opportunities to switch to more sustainable transport modes within and to west, north-west and central Cheltenham.
- Deliver a package of measures which is in keeping with the local environment and minimises any adverse environmental impacts.

The Scheme comprises three elements of works:

- An all-movements junction at M5 Junction 10;
- A new West Cheltenham Link Road east of Junction 10 from the A4019, to the West Cheltenham Cyber Park; and
- Widening of the A4019 to the east of Junction 10.

The Scheme is classed as a Nationally Significant Infrastructure Project (NSIP) under the Planning Act 2008, and as such requires a Development Consent Order (DCO) to proceed. This scoping report sets out the proposed scope of the Environmental Impact Assessment (EIA) to be undertaken for the Scheme, and is part of a formal request for a scoping opinion. Once agreed, the EIA will be undertaken and reported within an Environmental Statement that will be submitted with the application for development consent for the Scheme.

1. Introduction

1.1. Scheme Background

1.1.1. Gloucestershire faces significant challenges to achieve its vision for economic growth. A Joint Core Strategy (JCS)[1] – a partnership between Gloucester City Council, Cheltenham Borough Council (CBC) and Tewkesbury Borough Council (TBC) has been formed to produce a co-ordinated strategic development plan to show how the region will develop during the period 2011 - 2031. This includes a shared spatial vision targeting 35,175 new homes and 39,500 new jobs by 2041. Major development of new housing (c.9,000 homes) and employment land (c.100ha) is proposed in strategic and safeguarded allocations in the West and North West of Cheltenham, much of which lies within TBC's boundary as the Local Planning Authority. This development, in turn, is linked to wider economic investment, including a government supported and nationally significant 45 ha Cyber Central UK adjacent to GCHQ in West Cheltenham, as part of the Golden Valley Development, which also comprises the Garden Community Development. The Cyber Central UK hub is predicted to support c.7,500 jobs[2].

1.1.2. Cheltenham currently experiences significant congestion at peak times, which has led to air quality issues at various locations across the town and led to the creation of a Air Quality Management Area (AQMA) within Cheltenham. The existing M5 Junction 10 only provides access and egress to and from the north, with no connectivity to M5 south. This drives existing traffic across Cheltenham through various routes to access and leave the M5 from the south which contributes significantly to existing traffic flows in the town. To unlock the housing and job opportunities, a highways network is needed that has the capacity to accommodate the increased traffic it will generate, within a sustainable transport context.

1.1.3. An all movements junction has been identified as a key infrastructure requirement to enable the housing and economic development proposed by the Gloucestershire Local Enterprise Partnership's (GFirst LEP) Strategic Economic Plan and is central to the transport network sought by the council in the adopted Gloucestershire Local Transport Plan. The planned housing and economic growth have been included in the adopted JCS. Highways England also identified that improvements to M5 Junction 10 are a critical requirement to maintain the safe and efficient operation of the M5 corridor in their Birmingham to Exeter Route Strategy, whilst enabling the planned development and economic growth around Cheltenham, Gloucester and Tewkesbury.

1.1.4. A Business Case was submitted in March 2019 to Homes England to the Housing Infrastructure Fund (HIF), wherein an investment case was made for the following infrastructure improvements. Funding was successfully awarded by Homes England in March 2020:

- Element 1: Improvements to Junction 10 on the M5 and a new road linking Junction 10 to west Cheltenham;
- Element 2: A38/A4019 Junction Improvements at Coombe Hill;
- Element 3: A4019 widening, east of Junction 10; and
- Element 4: An upgrade to Arle Court Park and Ride.

1.1.5. Elements 1 and 3 comprise the M5 Junction 10 Improvements Scheme. The upgrade to Arle Court Park and Ride (now known as the Arle Court Transport Hub) and the junction improvements at Coombe Hill were included as part of the package of improvements funded by Homes England. Because they are located some distance from M5 Junction 10 and do not form part of the proposed improvement of the junction, Gloucestershire County Council (GCC) has decided to take these two elements forward as separate packages of

[1] Gloucester, Cheltenham and Tewkesbury Joint Coire Strategy 2011 – 2031, Adopted 11th December 2017.
[2] Golden Valley Development Supplementary Planning Document (July 2020), Cheltenham Borough Council and Tewkesbury Borough Council.

work in order to accelerate the programme for these elements, and will deliver them through separate planning strategies.

1.2. The Scheme

1.2.1. The Scheme under consideration herein comprises the following elements which are related to the changes to the strategic road network and together make up the M5 Junction 10 Improvements Scheme (hereafter referred to as the 'Scheme'):

- An all-movements junction at M5 Junction 10 (scheme element 1);
- A new West Cheltenham Link Road east of Junction 10 from the A4019 (scheme element 1); and
- Widening of the A4019 to the east of Junction 10 (scheme element 3).

1.2.2. The proposed infrastructure improvement elements that make up the Scheme are illustrated in Figure 1-1. Details of the JCS strategic allocations and the two safeguarded sites are shown in Figure 2-3.

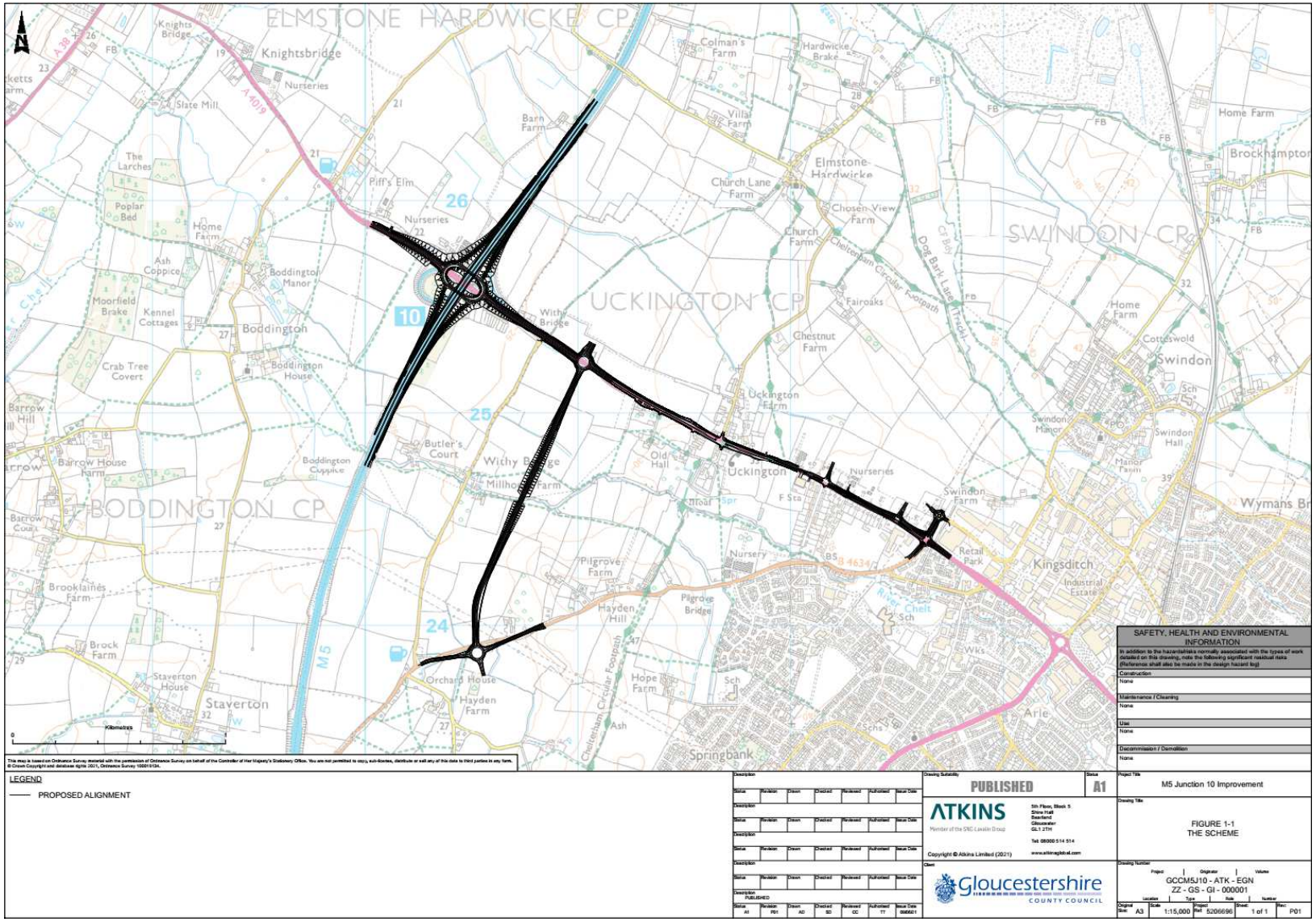

Figure 1-1 - The Scheme (showing the M5 J10, the A4019 and the West Cheltenham Link Road scheme elements)

1.3. Need for an Environmental Impact Assessment

1.3.1. The requirement for certain projects to report their effects on the environment is derived from European Union (EU) legislation initially in Council Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment. This legislation has been amended three times, in 1997, in 2003 and in 2009 with the amendments codified by Directive 2011/92/EU of 13 December 2011. The most recent changes have been adopted in UK legislation, for the purposes of planning applications, by the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 which transposes changes made to EU Directive 2011/92/EU1 ("the EIA Directive 2011") by EU Directive 2014/52/EU2. The related Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 ("the EIA Regulations 2017") govern development given planning consent through the nationally significant infrastructure planning regime. Their first revision in 2009 after the Planning Act 2008 was amended twice (2011 and 2012) prior to the revision made in 2017 to adopt EU Directive 2014/52/EU2.

1.3.2. The Scheme comprises an alteration of the M5, a highway lying wholly in England, for which Highways England, being a strategic highways company, is the highway authority. As the area of development for the alteration works will exceed the 15 hectares threshold prescribed in Section 22 (4) (a) of the Planning Act 2008 (as amended), the Scheme will be a Nationally Significant Infrastructure Project (NSIP) and likely to have a significant effect on the environment. This means that a Development Consent Order (DCO) application will need to be made to the Secretary of State under Section 37 of the Planning Act 2008 to seek authorisation to build the Scheme. An Environmental Impact Assessment (EIA) will be required as the Scheme is Schedule 2 development under the EIA Regulations 2017 (paragraph 10(f) – construction of roads). The Environment Statement (ES) resulting from the EIA, will be submitted as part of the DCO application.

1.3.3. The aim of the EIA is to protect the environment by ensuring that the Secretary of State, when deciding whether to grant Development Consent for a project which is likely to have significant effects on the environment, does so in the full knowledge of the likely significant environmental effects, and takes this into account in the decision-making process. The aim of the EIA is also to ensure that the public are given early and effective opportunities to participate in the decision-making process.

1.3.4. The EIA will be carried out by a team of specialists working in close collaboration with the design engineers responsible for the preliminary design of the Scheme as part of an iterative design, consultation and assessment process. This will maximise the opportunity to avoid or reduce adverse environmental effects at source and to identify the most effective mitigation of those effects that cannot be avoided.

1.4. Purpose of the Scoping report

1.4.1. This report has been prepared by Atkins on behalf of GCC in accordance with the Design Manual for Roads and Bridges (DMRB) 'LA 103 Scoping projects for environmental assessment'. It is also in accordance with the Planning Inspectorate (PINS) Advice Note Seven: Environmental Impact Assessment: Preliminary Environmental Information, Screening and Scoping (republished June 2020- version 7).

1.4.2. Scoping is a precursor to the environmental assessment process that will lead to the preparation of the EIA, which will be reported in an ES. A Preliminary Environmental Information Report (PEIR) will also be prepared, which will set out the effects of the Scheme as they are known before the ES is prepared, to inform stakeholders and the public during the statutory consultation ahead of the preparation of the ES.

1.4.3. The objectives of this Scoping Report are to:

- Present an initial understanding of the baseline conditions based on a review of existing data;
- Provide a preliminary evaluation of the sensitivity of identified resources and receptors;

- Provide justification, supported by evidence, for scoping in/out environmental factors (or any elements) from further environmental assessment;
- Define what level of environmental assessment (simple or detailed) is to be undertaken for those environmental factors (or any elements) scoped in;
- Specify the environmental assessment methodology and further data collection and survey requirements;
- Identify the study area for those environmental factors (or any elements) scoped in;
- Identify initial mitigation measures and environmental enhancements;
- Identify the overall likely level of impact of the Scheme, including consideration of potential cumulative effects; and
- Outline the future consultation process for the Scheme.

1.4.4. The Scoping Report also allows the 'scoping out' of environmental topics where little or no change to the existing situation will occur, thus leading to the preparation of a concise ES.

1.5. Structure and Contents of the Scoping report

1.5.1. The EIA Regulations 2017 set out the requirements for an applicant who proposes to request a scoping opinion from PINS. Regulation 10 (3) requires a request for a scoping opinion to include:

- A plan sufficient to identify the land;
- A description of the proposed development, including its location and technical capacity;
- An explanation of the likely significant effects of the development on the environment; and
- Such other information or representations as the person making the request may wish to provide or make.

1.5.2. PINS Advice Note Seven: Environmental Impact Assessment: Preliminary Environmental Information, Screening and Scoping provides advice on the information that should be provided in the Scoping Report. Table 1-1 below lists the information requirements and identifies where they are presented in this Scoping Report.

Table 1-1 - Suggested Scoping Report Contents in PINS Advice Note 7

Contents	Chapter in this Scoping Report
A plan showing:	
• The proposed draft site boundary (identified by a red line) including any associated development;	Figure 2-5
• Any permanent land take required for the proposed development;	Figure 2-5
• Any temporary land take required for construction, including construction compounds;	Figure 2-5
• Any existing infrastructure which would be retained or upgraded for use as part of the Scheme;	Included within Figure 1-1 and described in Chapter 2
• Proposed development and any existing infrastructure which would be removed; and	Included within Figure 1-1 and described in Chapter 2
• Features including planning constraints and designated areas on and around the site such as national parks or historic landscapes.	Figure 2-3 and Figure 2-4

Contents	Chapter in this Scoping Report
A description of the proposed development including both the NSIP and any of the associated development.	Chapter 2
In dealing with the description of the development and its possible effects on the environment, applicants should: • Set out the information using the headings in Schedule to the EIA Regulations 2017, being: - Characteristics of the development; - Location of the development; and - Characteristics of the potential impacts. Ensure that all aspects of the environment likely to be significantly affected by the development are addressed.	Chapters 5-15
An outline of the main alternatives considered and the reasons for selecting a preferred option.	Chapter 3
Results of desktop and baseline studies where available.	Chapters 5-15
Referenced plans presented at an appropriate scale to convey clearly the information and all known aspects associated with the proposal.	Figure 1-1
Guidance and practice to be relied upon, and whether this has been agreed with the relevant bodies together with copies of correspondence to support these agreements.	Chapters 5-15
Methods used or proposed to be used to predict impacts and the significance criteria framework used.	Chapters 5-15
Any mitigation proposed and predicted residual impacts.	Chapters 5-15
Where cumulative development has been identified, how the developer intends to assess these impacts in the ES.	Chapter 15
An indication of any European designated nature conservation sites that are likely to be significantly affected by the proposed development and the nature of the likely significant impacts on these sites.	Chapter 7
Where a developer seeks to scope out matters, a full justification for scoping out such matters, preferably supported by evidence of agreement with the relevant bodies.	Chapters 5-15
Key topics covered as part of the developer's scoping exercise.	Chapter 1
An outline of the structure of the proposed ES.	Chapter 4

1.5.3. This Scoping Report will be submitted to PINS to support a request for a Scoping Opinion on the proposals and the information to be supplied within the ES.

1.5.4. This Scoping Report will:

- Review existing data;
- Present the initial baseline conditions;
- Provide a preliminary evaluation of sensitivity on identified resources and receptors;
- Identify the topics which significant environmental effects are likely/unlikely to arise as a consequence of the works during construction and operation;
- Outline the scope, approach and methodology for each environmental topic 'scoped in' to the EIA Report;
- Identify mitigation and enhancements measures and residual effects; and
- Assess cumulative effects.

1.5.5. This Scoping Report covers the following topics referenced in DMRB LA 104:

- Air Quality (DMRB LA 105);
- Noise and Vibration (DMRB LA 111);
- Biodiversity (DMRB LA 108);
- Road Drainage and the Water Environment (DMRB LA 113);
- Landscape and Visual (DMRB LA 107);
- Geology and Soils (DMRB LA 109);
- Cultural Heritage (DMRB LA 106);
- Climate (DMRB LA 114);
- Materials and Waste (DMRB LA 110); and
- Population and Human Health (DMRB LA 112).

1.5.6. Table 1-2 outlines the structure of this Scoping Report. An Equality Impact Assessment (EqIA) will be produced and reported separately to the ES.

Table 1-2 - Structure of the Scoping Report

Structure of the Scoping Report	
Chapter 1 Introduction	
Chapter 2 The Scheme	
Chapter 3 Alternatives	
Chapter 4 Scope of the Assessment	
Chapters 5 to 14: Air Quality; Noise and Vibration; Biodiversity; Road Drainage and the Water Environment; Landscape; Geology and Soils; Cultural Heritage; Materials and Waste; Population and Human Health; Climate. All chapter sections are structured as follows: • Introduction; • Study area; • Planning policy and topic legislative context; • Baseline conditions; • Assumptions and limitations; • Potential impacts; • Potential effects and mitigation measures; • Likely residual effects; • Proposed level and scope of assessment; • Proposed assessment methodology; • Proposed consultation; and • Conclusion (including the identification of aspects scoped out of the assessment).	
Chapter 15	Cumulative Impact Assessment
Chapter 16	References
Appendix A	Surface water abstractions and discharges
Appendix B	Gazetteer of heritage assets

1.6. Responsible Organisation

1.6.1. The responsible organisation for the Scheme is GCC. Highways England (as the government owned company charged with operating, maintaining and improving England's motorways and major A roads) is the highway authority for the motorway elements of the Scheme. Funding for the construction of the Scheme will come from GCC

through the HIF monies awarded from the successful bid to Homes England for the Scheme.

1.7. Overseeing Organisation

1.7.1. The overseeing organisation for the Scheme is GCC.

1.8. The Designer

1.8.1. The designer is Atkins Ltd. Atkins has been appointed under GCC's Project Support Framework, by GCC, to undertake the preliminary design of the Scheme which includes EIA and the preparation of an ES for the Scheme.

1.9. Key Legislation and Policy

Legislative Framework

1.9.1. On the 12th March 2014, the European Parliament voted to adopt substantive amendments to the EIA Directive 2011/92/EU. These amendments made by EIA Directive 2014/52/EU were transposed into UK legislation in May 2017 including via the EIA Regulations 2017 and will be relevant to this Scheme and the topic assessments.

1.9.2. The EIA Regulations 2017 are UK legislation and, notwithstanding the UK withdrawal from the EU, remain in force until replaced.

Policy Overview

1.9.3. The Scheme represents a Nationally Significant Infrastructure Project (NSIP) for transport and a development consent order (DCO) application will be made under the Planning Act 2008. The principal policy document for the Scheme is therefore the National Networks National Policy Statement (NN NPS), published by the UK Government in 2014. Section 104(3) of the Planning Act 2008 requires the Secretary of State to decide the application in accordance with the NN NPS, except to the extent that certain other considerations apply.

1.9.4. A number of national, regional and local policy documents and strategies have the status of 'material considerations' in the determination of applications made for DCO for NSIP. Those of relevance to the Scheme are shown in Table 1-3 which includes a summary of the key messages and implications of each.

1.9.5. Policies contained within the national, regional and local policy and strategy documents identified in Table 1-3 are incorporated in the planning policy and legislative contextual sections of topic chapters where they have direct relevance to the assessment. A Direction from the Secretary of State in 2009 has saved a number of policies in the Cheltenham Borough Local Plan and so those policies remain in use alongside the Joint Core Strategy (JCS). The Draft Tewkesbury Borough Plan 2011 to 2031 has also been included in the review to capture any policies that could be adopted in the near future. Once adopted, this document will form part of the statutory local development plan for Tewkesbury Borough, together with the JCS.

1.9.6. A number of Supplementary Planning Documents (SPDs) from the relevant local planning authorities (LPAs) are also considered to be relevant to the Scheme as material considerations. These are not listed within Table 3-1, but are included in the assessments, as appropriate.

Table 1-3 - Policy Overview

Scale	Policy Document	Key Implication for the Scheme
National	National Networks National Policy Statement (NN NPS) (2014)[3]	Sets out the Government's policies to deliver NSIPs on the national road and rail networks in England. The Secretary of State uses the NN NPS as the primary basis for making decisions on DCO application for NSIPs made under the Planning Act 2008.
	National Planning Policy Framework (NPPF) (2019)[4]	Sets out the Government's planning policies for development seeking consent under the Town and Country Planning Act (1990) in England and how these should be applied. It forms a material consideration for the determination of NSIPs seeking a DCO under the Planning Act 2008.
	Road Investment Strategy 2 (RIS2) (April 2020)[5]	The M5 is part of the SRN and plays an important role in delivering economic growth. The document stresses that new housing and employment development should not place undue strain on the existing SRN and that the cumulative effects of new developments should be managed. The Scheme will support the operation of the SRN, improve safety for all users of the junction to reduce accident numbers and improve reliability of journey times through the junction.
	Birmingham to Exeter Route Strategy (March 2017)[6]	Published by Highways England (one of a number of Route Strategies produced to provide an analysis of the performance of the network), the Scheme has been identified as a critical requirement to maintain the safe and efficient operation of the M5 corridor, whilst enabling the planned development and economic growth around Cheltenham, Gloucester and Tewkesbury.
Regional	Gloucestershire Local Transport Plan (LTP) 2020-2041[7]	Sets out the transport issues and priorities for the county. The document identifies improvements to M5 Junction 10 as one of the main priorities for the county to support economic growth. Policy Document 4 'Highways' is particularly relevant to the Scheme.
	GFirst Local Enterprise Partnership Strategic Economic Plan[8]	The document outlines how the LEP aims to achieve improvements in economic growth to enable the LEP to support local businesses, develop the skills of workers in high-growth sectors, and maximise the connections and opportunities of the M5 corridor.
Local	Joint Core Strategy (JCS) 2011-2031 (2017)[9]	Sets out the long-term vision and objectives for development in Gloucester, Cheltenham and Tewkesbury, including housing and employment growth and the requisite supporting infrastructure.

[3] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf
[4] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/810197/NPPF_Feb_2019_revised.pdf
[5] https://www.gov.uk/government/publications/road-investment-strategy-2-ris2-2020-to-2025
[6] https://www.gov.uk/government/publications/route-strategies-april-2015-march-2020
[7] https://www.gloucestershire.gov.uk/transport/gloucestershires-local-transport-plan-2020-2041/
[8] https://www.gfirstlep.com/about-us/our-vision/strategic-economic-plan/
[9] https://www.jointcorestrategy.org/

2. The Scheme

2.1.1. The wider requirement for the Scheme is described in the Scheme Background section (Section 1.1) at the start of this document.

2.2. Scheme Objectives

2.2.1. The overall objectives for the Scheme are presented in Figure 2-1.

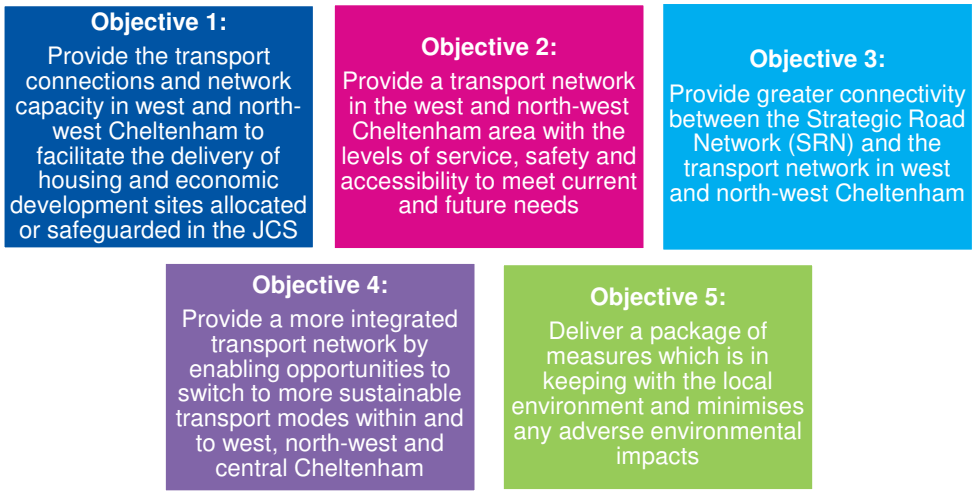

Figure 2-1 - Scheme Objectives

2.3. Scheme Location

2.3.1. M5 Junction 10 is located 48 miles to the south of Birmingham, 40 miles to the north of Bristol, 5 miles to the south of Tewkesbury, 4 miles to the north-west of Cheltenham, and 8 miles to the north-east of Gloucester.

2.3.2. The junction is in a strategically important location for the region, particularly as northern and western Cheltenham are the sites of a number of large retail parks and employment areas, and the location of planned future housing and nationally significant business development.

2.3.3. The location of M5 Junction 10 is shown in Figure 2-2.

Figure 2-2 - Location of the Scheme

2.3.4. The locations of the proposed infrastructure improvements that make up the M5 Junction 10 Improvements Scheme (and collectively make up the Scheme area), the JCS allocation areas and the two safeguarded sites to the north-west and west of Cheltenham are illustrated in Figure 2-3.

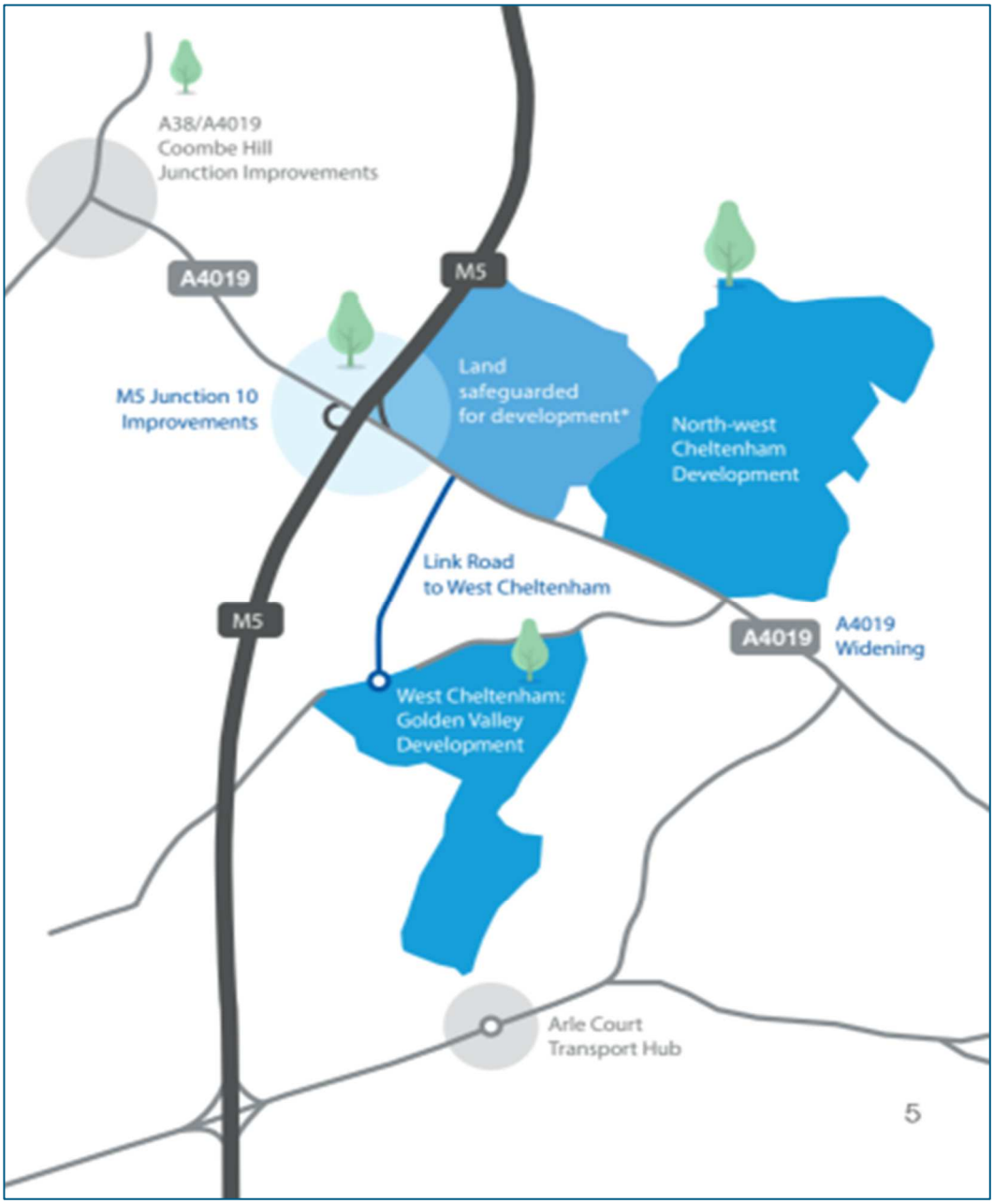

Figure 2-3 - Location of the M5 Junction 10 Improvements scheme elements (M5 Junction 10 Improvements, A4019 Widening, and the Link Road to West Cheltenham), the allocated land at West and North West Cheltenham, and the safeguarded land area

2.4. Scheme Elements

2.4.1. The proposed infrastructure improvement elements that make up the Scheme are illustrated in Figure 1-1. Details of the JCS strategic allocations are shown in Figure 2-3. A description of each element is presented below.

2.4.2. In addition to the three elements described below, there is the potential to designate Withybridge Lane as a 'Quiet Lane' as part of the Scheme. All works would be undertaken within the existing road corridor, and may range from new traffic signs and road marking enhancements, to physical narrowing of the existing lane.

M5 Junction 10

2.4.3. Improvements to M5 Junction 10 are to increase the capacity of the junction, and to upgrade the currently northbound only junction to an all-movements junction. To enable travel both south and north on the M5, the two existing Junction 10 exit sliproads will be removed, and four new slip roads will be constructed to provide access and egress to the M5 in all directions.

2.4.4. The preferred option for the Scheme was referred to as Option 2 at Project Control Framework (PCF) Stage 2 (PCF Stage 2)). The preferred option has a new elongated oval shaped roundabout junction to be constructed over the M5, centred either side of the existing overbridge, which is demolished. The A4019 is realigned to provide an appropriate entry angle to the new roundabout. A dedicated route for cyclists and pedestrians will be provided through the junction (see the section below on the A4019 Widening).

West Cheltenham Link Road

2.4.5. The West Cheltenham Link Road (the 'Link Road') is a proposed new two lane road, with a segregated cycleway and footway, from the B4634 to the A4019. The West Cheltenham Link Road is intended to provide greater connectivity between the reconfigured M5 Junction 10 and both the West Cheltenham Strategic Allocation, Safeguarded Land and the Proposed Cyber Park.

2.4.6. The Link Road crosses predominantly agricultural greenfield land. The design proposes a new viaduct structure across the floodplain and a clearspan bridge over the River Chelt.

2.4.7. To connect the Link Road with the existing A4019 (to the north) and the B4634 (to the south), two new roundabouts will be constructed:

- B4634 - a new four arm roundabout is proposed on the B4634 to connect both the Cyber Park and the West Cheltenham Strategic Allocation and Safeguarded Land to the M5 Junction 10 via the Link Road and the A4019. The location of this proposed roundabout is close to Hayden Hill Farm on the B4634, approximately 300m east of the junction for Withybridge Lane.
- A4019 - To facilitate the flow of traffic from the proposed Cyber Park via the Link Road, a new roundabout is proposed on the A4019. This will be a four-arm roundabout with the northern arm providing access to the new developments to the north of the A4019, as allocated in the JCS. Pedestrian access over this roundabout junction will be managed through the use of traffic light signalling when necessary. The preliminary design will identify the requirements for pedestrian crossings at this location.

A4019 Widening

2.4.8. The A4019 is currently a dual carriageway over the M5 Junction, returning to single carriageway near the junction to serve the turning to Withybridge Lane. As part of the highway improvements incorporated into the Scheme, the widening will be extended to continue from the M5 Junction 10 to an eastern extent at the Gallagher Retail Park, where the Scheme would tie into the existing dual carriageway. Widening through Uckington will be to the southern side of the A4019, and will incorporate accesses to propoerties.

2.4.9. The Scheme will also include a cycleway and footway adjacent to the A4019, which will cover the full extents of the proposed A4019 improvements and also provide connectivity for these facilities through the proposed M5 Junction 10 improvements to the access point with Stanboro Lane (west of M5 Junction 10).

Environmental Overview

2.4.10. M5 Junction 10 lies within the National Character Area (NCA) 106 Severn and Avon Vales as defined by Natural England 2012. The character is broadly defined as low lying agricultural vale landscape. It comprises soft, gently undulating to flat landscape, but with

intermittent locally elevated areas that project above the otherwise flatter landform. It has limited woodland cover with mature hedgerow trees.

2.4.11. The M5 transport corridor passes through the vale, aligned north south, beyond which is a network of local roads and lanes linking villages and hamlets. The most notable urban area is the town of Cheltenham located south-east of M5 Junction 10 and accessed via the A4019. Most of the area covered by the Scheme lies within land designated as Green Belt and consists mainly of agricultural and pastureland. There are electricity pylons towards the south east of Junction 10.

2.4.12. There are several residential properties close to the existing M5 Junction 10, which are arranged linearly along the A4019. The closest settlement to the Scheme is Uckington, a small village to the east of the existing M5 Junction 10 and west of Cheltenham, which is situated on the A4019; and a singular northern road extends to the village of Elmstone Hardwicke. Many of these houses lie within existing Noise Important Areas (NIAs) 3951 and 3949, which are designated due to traffic on the A4019.

2.4.13. Further east on the A4019, this landscape becomes increasingly urban where the Scheme runs into the western outskirts of Cheltenham. This urban landscape is characterised by the presence of numerous commercial premises, such as car dealerships, supermarkets and retail centres, as well as an increase in the number of residential properties. This eastern extent of the Scheme lies within the Cheltenham AQMA, as well as NIA 3948.

2.4.14. Multiple watercourses cross the Scheme study area, with watercourses running from east-west as eventual tributaries to the River Severn. Land to the south of the A4019 is affected by Flood Zones 2 and 3 associated with fluvial flooding of the River Chelt and a minor tributary.

2.4.15. Figure 2-4 of this Scoping Report shows a constraint map of the Scheme study area.

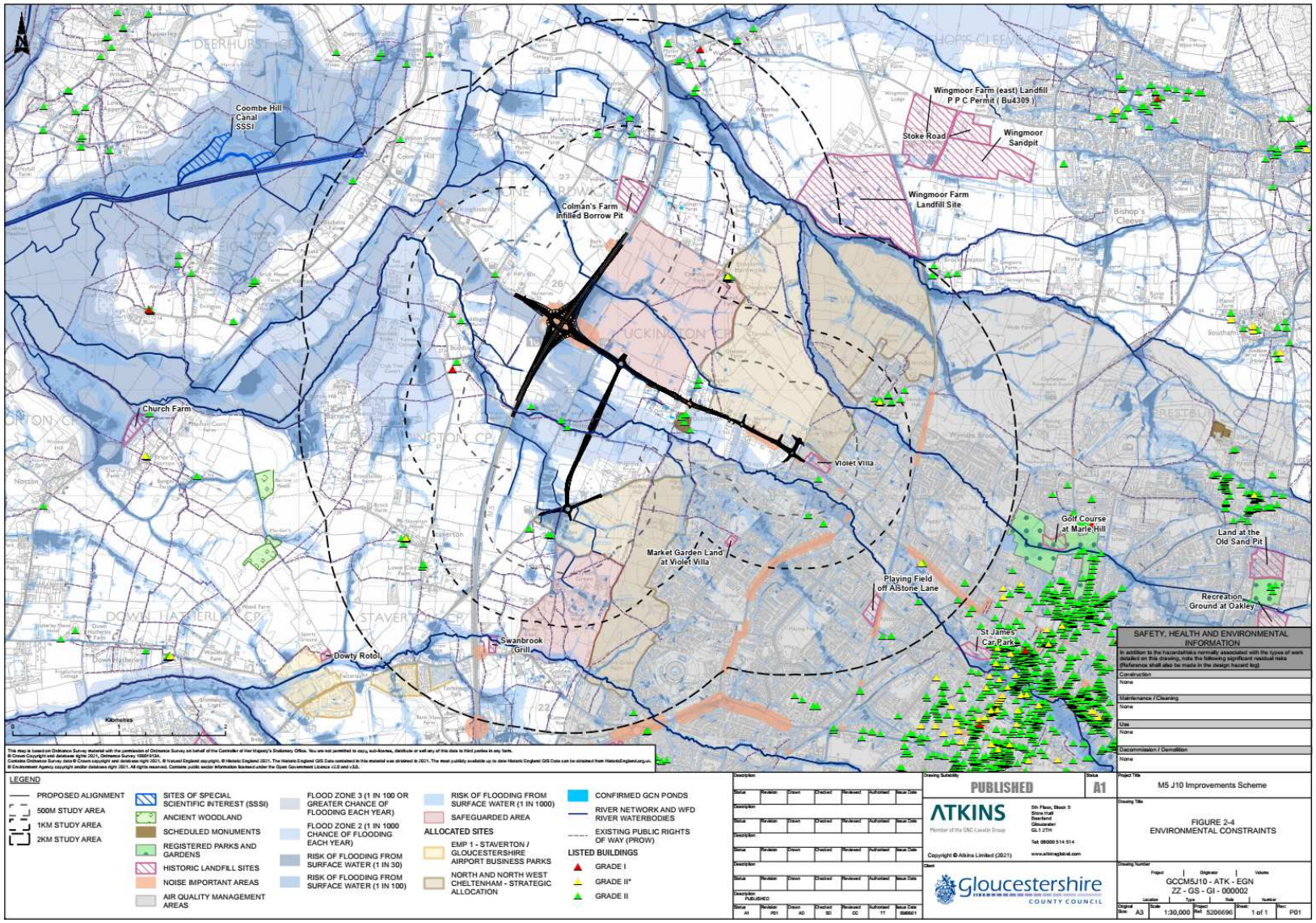

Figure 2-4 - Location of the Environmental Constraints within the Scheme study area

Land Take

2.4.16. The permanent land take (i.e. the areas outside the existing highway boundary but within the proposed highway boundary) required for the Scheme is shown in Figure 2-5. The permanent land take required would include a number of areas covered by environmental designations (including Green Belt).

2.4.17. The requirement for and extent of temporary land take is also shown in Figure 2-5. The land taken temporarily will be restored and returned to its original landowners after construction has been completed. As far as possible the land will be returned in the same condition as it was before the works commenced. Where this is not possible measures will be put in place to achieve this including management operations over a long period of time. In some cases it may be possible to return the land in an enhanced condition in agreement with the original landowner.

Construction, Operation and Long Term Management

2.4.18. Specific construction, operational and long term management arrangements are not known in detail at this stage of the Scheme. Potential locations of construction compounds for the contractor have been identified and are included within the temporary land take for the Scheme (Figure 2-5). The assessments of construction effects will assume best practice, based on industry guidance and professional experience. Construction of the Scheme is planned to commence in 2024, with the Scheme planned to be open for traffic in 2025.

Decommissioning

2.4.19. In view of the indefinite design life of the Scheme, it is not considered appropriate for decommissioning to be included in the environmental assessments, rather the focus will be upon seeking to minimise disruption and to re-use materials that will also form part of the materials assessment.

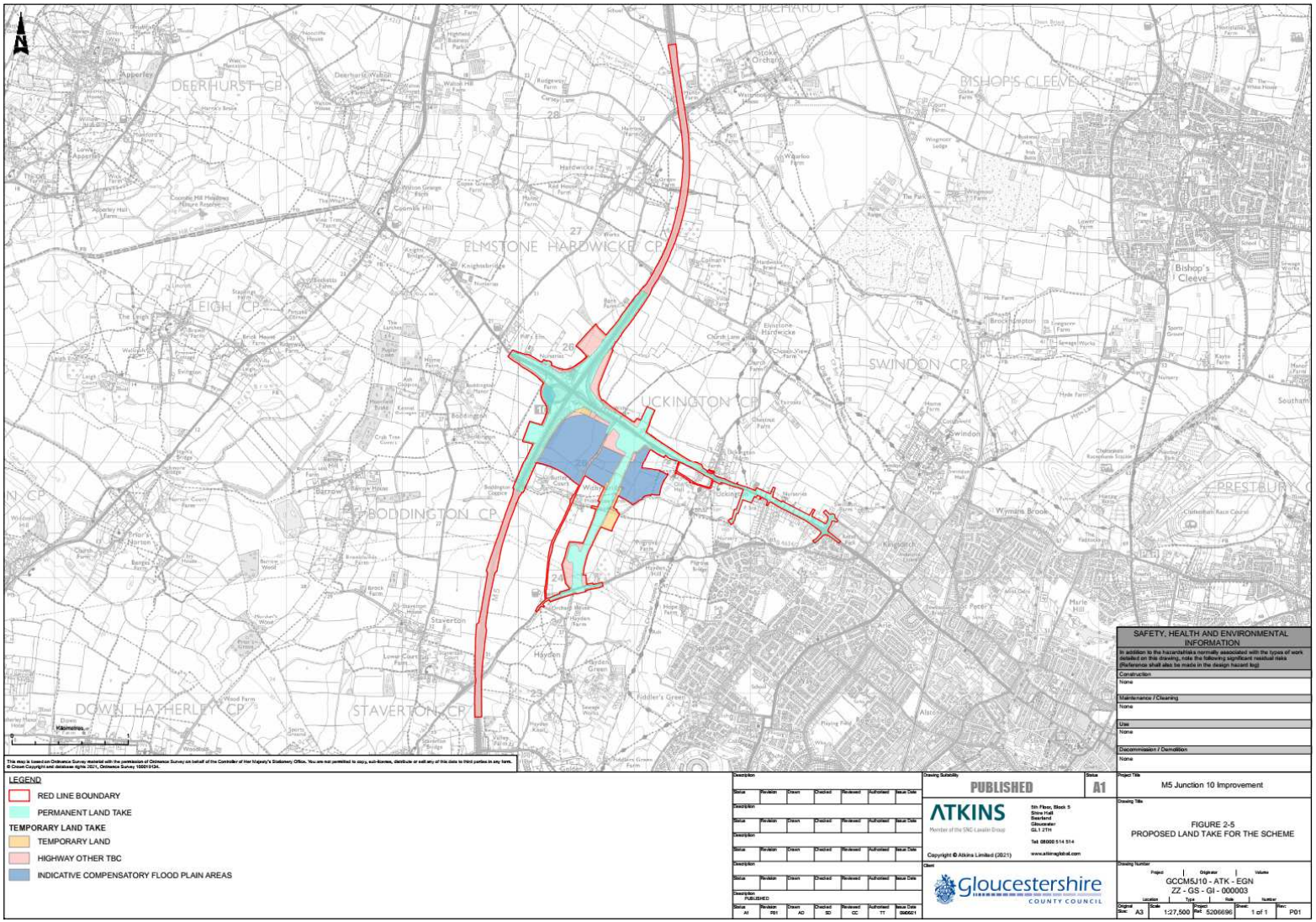

Figure 2-5 - Proposed land take for the Scheme (note that the land take north and south of the M5 Junction 10 (beyond the permanent land take area) covers the locations required for new signage. Land required for new signage will all be within the existing highway boundary)

3. Alternatives

3.1. Strategic Alternatives

3.1.1. In preparation for the JCS, multiple options were considered to deliver the infrastructure improvements required to deliver the housing in the North-West Cheltenham and West Cheltenham allocated sites. Once the projects that form part of the M5 Junction 10 Improvements Scheme were agreed, optioneering about the type of junction at M5 Junction 10 has largely been the focus for the Scheme, as it has the greatest impact on the delivery of the housing identified in the JCS.

3.1.2. Between 2015 and the adoption of the JCS in 2017, a range of infrastructure options were considered in relation to the required housing numbers and whether these met the high-level social, economic and political goals expected of the JCS. These are listed below and were tested using a traffic model to determine their efficacy:

- do minimum, delivering only the committed network improvements to 2031. This option failed to support the required JCS housing growth;
- DS1 (Do Something 1, a low-cost transport solution, primarily schemes fully within existing highway boundaries. This scenario also failed to support the required housing delivery;
- DS2 to DS6a, which introduced increasing levels of investment alongside demand management interventions. DS6 introduced the 'all movements' Junction 10, which was shown to meet the needs of the JCS site allocations in west and north-west Cheltenham (i.e. those which are the subject of the HIF Business Case for the Scheme) but not to the wider demands; and
- DS7, incorporating M5 Junction 10 improvements, plus additional schemes not within the scope of the HIF Business Case. This was the scenario accepted by the Inspector at the Examination in Public for the JCS.

3.1.3. Due to the inability of the other schemes considered to provide the suitable capacity to facilitate the housing growth, the need was identified for the M5 Junction 10 work to commence.

3.2. A4019

A4019 Scheme History

3.2.1. In August 2016 a transport assessment was prepared as part of the Elms Park (North West Cheltenham) development application. This transport assessment included plans to improve the A4019 over the approximate extents from the Cheltenham West Community Fire Station to its junction with the B4633 Gloucester Road, with sections of widening to provide a dual carriageway, bus lanes and improved pedestrian and cyclist facilities. These plans also included the upgrade of existing junctions and the inclusion of new junctions to access the proposed development.

3.2.2. Following this development application, Amey Consulting developed a Concept Option for extending the proposed improvements of the A4019 to the west to link to the proposed M5 Junction 10 and West Cheltenham Link Road improvements. These proposed improvements included the widening and upgrade of the existing A4019 to dual carriageway standard with improvements to existing junctions. The Concept Option was included and assessed in the Homes England Business Case for funding in March 2019.

Options Identification

3.2.3. Following submission of the Homes England Business Case, a review was undertaken to consider the Concept Option included within the submission and to identify other potential options for widening. The advantages and disadvantages of each option in relation to known constraints were considered.

3.2.4. As part of this exercise, options for wide single carriageways and part widening of the A4019 were considered. WebTAG TAG Unit A5.4 – Marginal External Costs includes guidance on average capacities for urban roads by road type and geographical area. Table A2 includes Cheltenham in Area 7 – Urban large (>100,000) and using this area in Table A6 for an 'A Road' gives a suggested average capacity (PCU per lane km per hour) of 1100. However, following an assessment using forecast traffic flows obtained from the Scheme Saturn model, this showed that all the individual links along the A4019 within the study area had a forecast flow exceeding 1100 pcu in either the eastbound, westbound or both carriageways, so this would rule out these options.

3.2.5. The options that were considered most likely to provide the benefits required and have the least impact on known constraints were identified. These were:

- Option 1 – Standard dual carriageway (D2UAP);
- Option 2 – Reduced central reserve width dual carriageway; and
- Option 3 – No central reserve dual carriageway.

3.2.6. As part of the above exercise, the potential for alternative route corridors were considered but none were identified due to severity of impacts on land, existing property and proposed developments.

Sifting at Options Identification Stage

3.2.7. A sifting exercise was undertaken on the above three concept options based on an assessment of their ability to provide the benefits required.

3.2.8. The difference between Options 1, 2 and 3 relates to the proposed width of the central reserve and imposed speed limit. Lane widths, verge widths and walking/cycling facilities are common on all three options. Within Option 1 the central reserve width would be 1.8m, Option 2 would have a central reserve width of 1m and Option 3 would not have a central reserve. Due to the reduced width and removed central reserve in Options 2 and 3 respectively, it is considered that a reduction in the speed limit from 50mph to 40mph would be required.

3.2.9. With the central reserve width in Option 1 there would be sufficient width to provide a vehicle restraint system with an allowable relaxation in the set-back value. With a vehicle restraint system in place it would be considered acceptable to maintain the existing 50mph speed limit if required.

Preferred Option

3.2.10. With the reduced central reserve width in Option 2 and no central reserve in Option 3 a vehicle restraint system would not be able to be provided between opposing traffic flows. This would result in the safety of the options being compromised. Partial mitigation for this would be to reduce the speed limit to 40mph. However, even with a reduced speed limit it is considered that neither of these options would be as safe as Option 1 and neither would they significantly reduce the impact on land and properties to the north of the A4019. They were therefore sifted out at this stage.

3.3. M5 Junction 10

M5 Junction 10 Scheme history

3.3.1. A variety of studies, option identification and sifting exercises have previously been carried out related to the improvement of the M5 Junction 10 as described in the following paragraphs.

3.3.2. Previous study work was undertaken by Highways England in July 2012 and February 2018.

3.3.3. JMP Consultants Ltd produced a report in July 2012 titled "M5 Junction 10 – Feasibility Study of conversion to an all movements junction". This considered four options for converting the existing junction into an all movements junction. All options proposed to

keep the existing northbound entry slip loop and avoid any impact on the commercial properties in the north west quadrant. They also sought to minimise the impacts on the residential properties on Withybridge Gardens. Because of this, all four options included at least one signalised slip road junction with the A4019.

3.3.4. A report produced by Aecom in February 2018 titled "Option Assessment Report – M5 Junction 10 and access to the Cyber Park Access Road" identified several options which included both improvements to Junction 10 and various different modelling scenarios.

West Cheltenham Link Road Options

3.3.5. Six outline options for a proposed West Cheltenham Link Road and improved/new M5 Junction 10 were developed by Amey Consulting in July 2018. These included various arrangements of a full movement Junction 10 located south, at, and north of the existing junction. A comparison of the options led to the development of three Concept Options included in the Homes England Business Case.

Homes England Business Case Concept Options

3.3.6. Amey Consulting developed three Concept Options from the previous six, which were included and assessed in the Homes England Business Case for funding in March 2019. These were:

- Concept Option 1 – Junction 10 moved north of its existing location;
- Concept Option 2 – Upgrade to the existing Junction 10; and
- Concept Option 3 – Junction 10 moved south of its existing location, including a direct link to the B4634.

3.3.7. These options were reviewed for engineering constraints to understand which options offered the best performance and value for money.

Options Identification

3.3.8. A workshop was held, attended by specialists in engineering, environmental and traffic modelling, to consider all previous options identified and to identify potential new options. The advantages and disadvantages of each option in relation to known constraints were discussed and recorded. The options that were considered most likely to provide the benefits required and have the least impact on known constraints were identified. These were:

- Option 1A – As per Concept Option 1, but with Junction 10 roundabout configuration amended to an elongated junction – New Junction North of Existing;
- Option 2 – As per Concept Option 2 – Upgrade Existing Junction with Gyratory Roundabout;
- Option 2A – As per Concept Option 2, but the junction moved slightly north to enable the retention of the existing bridge as the southern part of the gyratory carriageway;
- Option 3 – As per Concept Option 3 – New Junction South of Existing;
- Option 4 – As per Concept Option 2, but with a dumbbell roundabout arrangement instead of a gyratory roundabout; and
- Option 5 –As per Concept Option 1, but with the junction located not as far north of the existing junction.

Sifting at Options Identification Stage

3.3.9. A sifting exercise was undertaken on the above six concept options. A qualitative assessment was carried out using a range of Economic/Engineering, Environmental and Social/Cultural criteria and the options were scored on a seven-point scale.

3.3.10. Options 3 and 4 were considered to have less benefits or greater impacts relative to the other options and were therefore sifted out at this stage.

3.3.11. As part of this process, it became apparent that there was a further sub-option of Option 2, which was similar to Option 2A, but moved the junction slightly south, to enable the retention of the existing bridge as the northern part of the gyratory carriageway. This layout was called Option 2B.

3.3.12. The options carried forward to the appraisal stage were therefore:

- Option 1A – New Junction North of Existing;
- Option 2 – Upgrade Existing Junction with Gyratory Roundabout;
- Option 2A – Upgrade Existing Junction with Gyratory Roundabout offset to the north;
- Option 2B – Upgrade Existing Junction with Gyratory Roundabout offset to the south; and
- Option 5 – New Junction North of Existing (in alternative position to Option 1A).

3.3.13. The five route options are indicated in Figure 3-1 below.

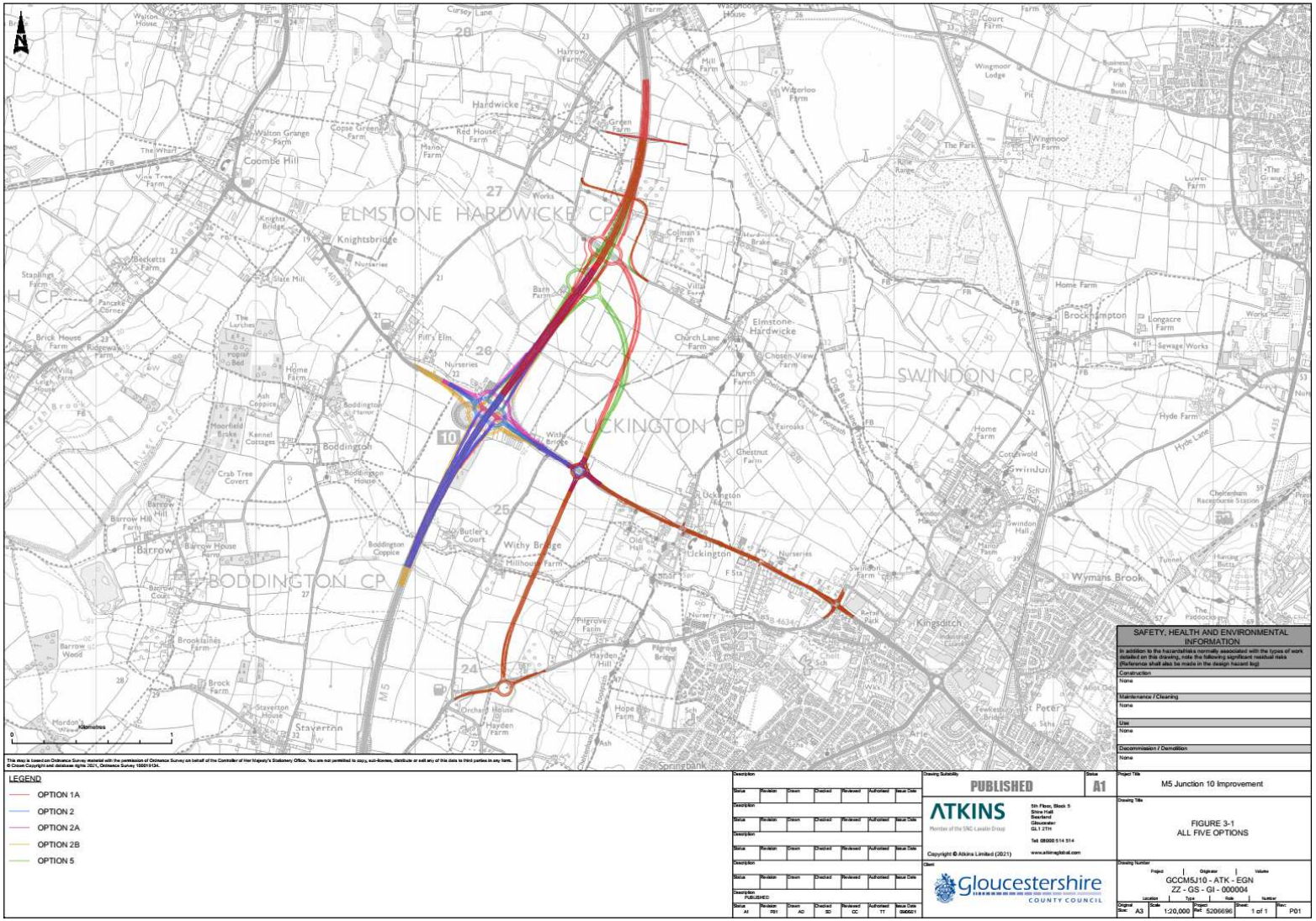

Figure 3-1 - Options 1A, 2, 2A, 2B and 5 for the M5 Junction 10 Improvements Scheme (without earthworks). All five options include the widening of the A4019 and the West Cheltenham Link Road

Description of Options Carried Forward for Appraisal

3.3.14. All five options included the following four elements:

- A new 'on-line' roundabout on the A4019 to provide the junction with West Cheltenham Link Road;
- The proposed West Cheltenham Link Road between the A4019 and the B4634 roads;
- A new roundabout connecting the West Cheltenham Link Road to the proposed Cyber Park and B4634; and
- Widening of the A4019 towards Cheltenham up to the existing dualled highway adjacent to Gallagher Retail Park.

3.3.15. The following sections provide further details of the options carried forward for appraisal.

Option 1A – New Junction North of Existing

3.3.16. Option 1A proposed a new M5 gyratory roundabout junction with two new overbridges, replacing the existing Harwicke Elmstone Hard Bridge approximately 1250m north of the existing M5 Junction 10. This junction would provide access to the M5 in all directions. As a result the existing northbound on-slip and south bound off-slip at Junction 10 would no longer be required.

3.3.17. A new 50mph two-lane dual carriageway would connect the new M5 junction with the A4019 Tewkesbury Road by means of a new gyratory roundabout junction approximately 650m east of the M5. From this junction the new dual carriageway would continue south, passing over the River Chelt before tieing into the B4634 Gloucester Road approximately 300m east of the existing Withbridge Lane Junction. This section of dual carriageway would provide continuity from the new M5 Junction while moving the traffic from Withybridge Lane.

3.3.18. In addition to the new sections of dual carriageway, it proposed that the A4019 Tewkesbury Road, between the new gyratory roundabout and traffic signalised B4634 junction would be widened to provide a two lane dualled carriageway. New signalised junctions would be required at the staggered crossroads of The Green and Moat Lane in Uckington and at Homecroft Drive junction.

3.3.19. As part of the improvement works, the existing Green Farm Access Bridge would be demolished and replaced at the same location with a new longer overbridge spanning the new slip road tapers. Another new bridge would be provided approximately 400m south to replace the demolished Hardwicke-Elmstone Hard Bridge.

3.3.20. This option would also impact upon approximately 50% of a storage area at Bank Farm.

Option 2 – Upgrade Existing Junction with Gyratory Roundabout

3.3.21. Option 2 proposed that the existing M5 Junction 10 overbridge be demolished and a new elongated oval shaped roundabout junction be constructed over the M5, centred either side of the existing overbridge. To construct this roundabout and to tie into the existing A4019, the properties to the north and south of the A4019 carriageway would need to be demolished. Slip roads would connect the junction to the M5, providing access in all directions.

3.3.22. The connecting sections from the new junction to both the east and west were proposed to be dualled, the west tying in approximately 250m west of the M5 Junction, while the east ties in to a new A4019 gyratory roundabout junction approximately 650m east of the junction. A connection stub to the north would be constructed for potential future development. From this roundabout a new road (the West Cheltenham Link Road) would continue south, passing over the River Chelt before tying into the B4634 Gloucester Road with a new gyratory roundabout approximately 300m east of the existing Withbridge Lane Junction.

3.3.23. In addition to the new sections of dual carriageway, the option proposed that the A4019 Tewkesbury Road, between the new gyratory roundabout and traffic signalised B4634

junction was widened to provide a two lane dualled carriageway. New signalised junctions would be required at the staggered crossroads of The Green and Moat Lane in Uckington and at Homecroft Drive junction.

3.3.24. This option would impact upon all fourteen of the residential properties at Withybridge Gardens, the two properties on the A4019, a large proportion of the buildings at Sheldon Nurseries and the three properties nearby, and approximately a third of the Barn Farm storage area.

Option 2A – Upgrade Existing Junction with Gyratory Roundabout offset to the north

3.3.25. Option 2A is the same as Option 2 (and Option 2B) except for the changes to the existing M5 Junction 10.

3.3.26. For the M5 Junction 10, Option 2A proposed that the upgrade of the existing M5 Junction 10 to a gyratory roundabout junction would utilise the existing M5 overbridge as the southern part of the roundabout and construct one new overbridge north of the A4019. To construct the gyratory roundabout and tie the junction into the existing A4019, the properties to the north of the carriageway, both east of and west of the M5 would need to be demolished. Slip roads connect the junction to the M5, providing access in all directions.

3.3.27. This option would impact upon at least four of the residential properties at Withybridge Gardens, the two properties on the A4019, a large proportion of the buildings at Sheldon Nurseries and the three properties nearby, and approximately a third of the Barn Farm storage area.

Option 2B – Upgrade Existing Junction with Gyratory Roundabout offset to the south

3.3.28. Option 2B is the same as Option 2 (and Option 2A) except for the changes to the existing M5 Junction 10.

3.3.29. For the M5 Junction 10, Option 2B proposed that the upgrade of the existing M5 Junction 10 to a gyratory roundabout junction would utilise the existing M5 overbridge as the northern part of the roundabout, and construct one new overbridge south of the A4019. To construct the gyratory roundabout and tie the junction into the existing A4019, the properties to the south of the carriageway would need to be demolished. Slip roads connect the junction to the M5, providing access in all directions.

3.3.30. This option would impact upon all fourteen of the residential properties at Withybridge Gardens, a large proportion of the buildings at Sheldon Nurseries and two of the properties nearby, and approximately a third of the Barn Farm storage area.

Option 5 - New Junction North of Existing (in alternative position to Option 1A)

3.3.31. Option 5 proposes a new M5 gyratory roundabout junction with two new overbridges, south of the existing Hardwicke Elmstone Hard Bridge which would be demolished, approximately 1000m north of the existing M5 Junction 10. This junction would provide access to the M5 in all directions, as a result the existing northbound on-slip and south bound off-slip at Junction 10 will no longer be required. To accommodate the new M5 Junction, some buildings at Barn Farm would also have to be demolished and the existing access road to the farm realigned.

3.3.32. A new 50mph two-lane dual carriageway would connect the new M5 Junction with the A4019 Tewkesbury Road by means of a new gyratory roundabout junction approximately 650m east of the M5. From this junction the new 50mph dual carriageway would continue south, passing over the River Chelt before tying into the B4634 Gloucester Road approximately 300m east of the existing Withbridge Lane Junction. This section of dual carriageway provides continuity from the new M5 Junction while moving the traffic from Withybridge Lane.

3.3.33. In addition to the new sections of dual carriageway, it is proposed that the A4019 Tewkesbury Road, between the new gyratory roundabout and traffic signalised B4634 junction is widened to provide a two lane dualled carriageway. New signalised junctions

would be required at the staggered crossroads of The Green and Moat Lane in Uckington and at Homecroft Drive junction.

3.3.34. As part of the improvement works, the existing Green Farm Accommodation Bridge would be retained.

3.3.35. This option would not impact upon any of the residential properties at Withybridge Gardens, the two properties on the A4019, Sheldon Nurseries and the three properties nearby. However it would affect all buildings and storage areas at Barn Farm.

Options carried forward for Public Consultation

3.3.36. At PCF Stage 2, Atkins was commissioned to provide a Technical Appraisal Report (TAR) of the options at the appraisal stage and a Preliminary Environmental Assessment of Options Report (PEAOR).

3.3.37. The TAR brought together the traffic, economic, safety and environmental assessments and formed the basis for deciding which option(s) should be included in the Public Consultation. It was concluded that Option 1A and 5 should not be taken any further forward due to the complexities and affordability issues.

3.3.38. It was recommended that Options 2, 2A and 2B are taken forward for further development, having all achieved a “High” value for money (VfM) category. Although all options met the Scheme objectives fully, there was marginal difference in overall benefits or disadvantages of these recommended options when compared with each other. Due to this marginal difference in benefits and disadvantages it was not possible to confirm a preferred solution at that stage. Therefore, it was proposed that Options 2, 2A and 2B be taken forward to the next stage for public consultation.

Preferred Option

3.3.39. Following the public consultation, a Stage Overview of Assessment Report was produced that considered the comments and views expressed during the public consultation exercise to provide a recommendation for the Preferred Option.

3.3.40. Option 2 is the option that Gloucestershire County Council recommended should be taken forward to an application for consent to construct. The details of Option 2 are those set out above in the description of the Scheme elements (Section 2.4) and Figure 1-1. The preferred route was announced on the 16th June 2021.

Design Developments post Consultation

3.3.41. Further assessment and design development work has been carried out since the public consultation was held. This has taken into account feedback received during the public consultation and the results of ongoing survey and assessment work.

3.3.42. This work has considered:

- Review of the alignment and cross section of the West Cheltenham Link Road;
- A4019 widening at Uckington;
- Extending the improvement works on the A4019 eastwards as far as Gallagher Retail Park (junction of the A4019 and B4634); and
- ‘Quiet Lane’ designation for Withybridge Lane.

West Cheltenham Link Road

3.3.43. Five variations in the alignment of the route shown at the public consultation were developed and assessed. All variations are within the same route corridor, with the main difference being how each option crossed the River Chelt. Options 1 and 3 avoided a requirement for an engineered river channel for the River Chelt at the crossing point. Of these two options, Option 3 was slightly preferential from a land impact perspective.

3.3.44. The PCF Stage 2 design of the Link Road was for a two-lane dual carriageway for its full extent. Updated traffic modelling identified that the estimated peak traffic flows in both

directions would be within the capacity of a single lane, and therefore a single carriageway layout would provide sufficient capacity for the forecast flows.

A4019 Widening at Uckington

3.3.45. Options were considered for widening the A4019 to the north or to the south through Uckington.

- Widening to the north would impact on eleven separate plots on the northern side of the A4019 at Uckington, including the potential requirement to demolish at least two residential properties and result in the significant loss of frontages to six residential properties. Land take would be required in nine separate plots to achieve the widening to the northern side at Uckington.
- Widening to the southern side of the A4019 would impact on six separate plots located to the south of the A4019, and would require the potential demolition of three residential properties and a farm building.
- Widening to both the north and south sides of the A4019 would require land take within at least fifteen separate plots, affecting almost every plot bounding the A4019 at the Uckington junction. This option would result in the loss of frontages to eleven properties and require the potential demolition of a farm building.

3.3.46. The review concluded that widening to the southern side of the A4019 at Uckington would be the preferable option, as it would impact a lesser number of plots/properties, and also allow for the introduction of pedestrian crossings on the A4019 at the junction with Moat Lane and The Green.

Eastern Extent of the Scheme on the A4019

3.3.47. The eastern extent of the Scheme on the A4019 has been extended to the Hayden Road junction at Gallagher Retail Park. This is to include the accesses to the future North West Cheltenham Development site (also referred to as the Elms Park Development site).

Withybridge Lane – 'Quiet Lane' Designation

3.3.48. There is potential for designating Withybridge Lane as a 'Quiet Lane' for further enhancement to the walking, cycling and horse-riding facilities in the area.

3.3.49. Traffic calming and traffic management measures would be required to achieve the guideline traffic and speed conditions (Local Transport Note 1/20)[10], and these would be designed to be in keeping with the local environment. Traffic calming options could range from physically narrowing the existing lane to a single lane track with passing places, using the width of the redundant carriageway for walking, cycling and horse-riding facilities, to simpler traffic signs and road marking enhancements.

[10] Local Transport Note 1/20 - Cycle Infrastructure Design (publishing.service.gov.uk), 2020.

4. Scope of the Assessment

4.1. General Approach

4.1.1. EIA is a process for identifying the likely environmental effects (positive and negative) of proposed developments, and their significance. Under the EIA Regulations 2017 the Secretary of State may not grant development consent for the Scheme unless EIA has been carried out.

4.1.2. The aim of an EIA is to ensure that the following are undertaken:

- A thorough assessment of likely effects of a proposed development on the environment;
- Consideration of mitigation measures and alternatives in light of potential environmental effects; and
- Assessment of the cumulative effects of the proposed development.

4.1.3. Through this process the Scheme should include measures to prevent, reduce or offset any significant, adverse environmental effects of the proposals, and enhance the positive impacts. The findings of the assessment will be presented in the ES.

4.1.4. This chapter describes the EIA process in conformance with DMRB requirements. For highways projects, DMRB is recognised as providing an appropriate methodology for the assessment of environmental effects. For some topics the DMRB methodology will be supplemented by separate standards and best practice guidance where it improves the assessment of effects. Where there is no standard guidance this is stated, together with the methodology used to undertake the assessment.

4.1.5. The 2017 update to the EIA Regulations requires consideration of a number of topics that were not previously included or were considered in a different format. These are:

- Biodiversity with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC (previously flora and fauna);
- Population and human health (previously population);
- Land (not previously included);
- Vulnerability of the project to risks of major accidents and/or disasters that are relevant to the project concerned;
- Climate; and
- Heat and radiation.

4.1.6. DMRB already covers Biodiversity (LA 108), Climate (LA 114), Population and Human Health (LA 112) and Land (LA 107) in existing topics but Vulnerability, and Heat and Radiation are not currently included. Guidance from Highways England suggests that Vulnerability to risks of major accidents and/or disasters should be included in existing topic chapters. It further recommends that Heat and Radiation are scoped out as they are not relevant to highways schemes.

4.2. The EIA Process

The Design Manual for Roads and Bridges (DMRB)

Overview

4.2.1. The DMRB is a suite of documents which contains requirements and advice relating to works on motorway and all-purpose trunk roads through design, construction and operational stages of the highways assets.

4.2.2. The DMRB embodies the collective experience of the highway authority, their agents and designers. It provides requirements and advice resulting from research, practical

experience of constructing and operating motorways and all-purpose trunk roads, and from delivering compliance to legislative requirements.

4.2.3. DMRB LA 101 'Introduction to Environmental Assessment' outlines the approach to assessment that may be relevant dependent upon the potential environmental effects and the stage of the project. The assessment levels are defined as:

- Screening - Screening determines if a project requires an EIA and publication of an ES in line with the requirements of the Directive 2011/92/EU as amended by 2014/52/EU.
- Scoping - Scoping shall be undertaken in accordance with LA 103. Scoping provides justification and evidence for:
  - Further assessment (or not) of environmental factors;
  - The level of assessment to be undertaken;
  - The approach to consultation; and
  - The environmental assessment methodologies / study areas.
- Simple Assessment - Typically based on the data and information that is readily available and fulfils one of three functions:
  - To address potential aspects identified at the scoping level;
  - To reach an understanding of the likely environmental effects to inform the final design or assessment; or
  - To reach an understanding of the likely environmental effects that identified the need for a Detailed Assessment.

4.2.4. The Simple Assessment would be sufficient if it established confidently that the forecast environmental effect would not be a fundamental issue in the decision-making process.

- Detailed Assessment - Likely to require detailed field surveys and/or quantified modelling techniques. Detailed assessments would be undertaken where there is the potential to cause significant effects on environmental resources and receptors. The objective of this level of assessment is to gain an in-depth appreciation of the beneficial and adverse effects of the project.
- Monitoring - Where significant adverse environmental effects are reported in ES's, monitoring of these effects shall be undertaken in accordance with LA 104 Environmental assessment and monitoring. The purpose of monitoring is to:
  - Ensure measures envisaged to avoid, prevent or reduce and, if possible, offset significant adverse effects on the environment are delivered;
  - Build data on the effectiveness of design and mitigation measures thereby driving improvement in environmental performance for future projects;
  - Satisfy licence / permit requirements (where applicable); and
  - Identify remedial action as a consequence of under-performance or failure of mitigation. These levels are not intended to be sequential, but consequential.

Scoping

4.2.5. Prior to the commencement of works on the environmental assessment the scope of the environmental assessment will be established. The objective of this is to identify the environmental topics to be taken into account in the design of the Scheme and to set out the methodology for assessment. This assessment will ascertain which environmental topics are to be examined in greater detail i.e. a simple or detailed assessment, and which can be 'scoped out' (basic assessment) in accordance with LA 103.

4.2.6. The scoping process requires a good understanding of the existing environment and the Proposed Development. A gap analysis is undertaken to identify what further studies are required to gain a detailed understanding of the receiving environment. This could involve consultation with stakeholders to acquire existing data or where this does not exist, surveys can be undertaken.

4.2.7. Teams of experts that specialise in specific environmental topics consider the Proposed Development and what impacts are likely to arise. This exercise is completed using

professional judgement and experience from similar projects and through consultation with statutory stakeholders who have detailed knowledge of the types of impacts that can arise from projects.

4.2.8. For each environmental topic, a list of the impacts that can arise during both construction and operation of the Scheme is produced and a commentary is provided setting out the justification as to why resulting environmental effects are likely to be significant or not. This forms the basis of the proposed scope of the EIA which is confirmed or added to by the Competent Authority (in this case PINS (on behalf of the Secretary of State) with reference to other bodies such as Natural England) through the issue of a Scoping Opinion.

4.2.9. This Scoping Report covers the following topics referenced in DMRB LA 104:

- Air Quality (DMRB LA 105);
- Noise and Vibration (DMRB LA 111);
- Biodiversity (DMRB LA108);
- Road Drainage and the Water Environment (DMRB LA 113);
- Landscape and Visual (DMRB LA 107);
- Geology and Soils (DMRB LA 109);
- Cultural Heritage (DMRB LA 106);
- Climate (DMRB LA 114);
- Materials and Waste (DMRB LA 110); and
- Population and Human Health (DMRB LA 112).

4.2.10. For each environmental topic, a different level of assessment may be appropriate. The topic chapters below (Chapters 5 to 14) state whether the topic is to be 'scoped in' to the EIA and whether a simple or detailed assessment will be required.

4.2.11. Each of these topics is considered in individual chapters following the same format and structure. For each topic, the current knowledge of the existing environment is summarised and any knowledge gaps are identified.

4.3. Proposed EIA Approach for the Scheme

4.3.1. The key stages of the EIA process for the Scheme at this stage are:

- Scoping;
- Defining the study area;
- Establishment of baseline conditions;
- Consideration of alternatives;
- Consultation;
- Impact assessment and identification;
- Defining assessment years;
- Development of mitigation measures;
- Prediction of residual environmental effects;
- Cumulative impact assessment;
- Transboundary impacts; and
- Environmental management.

4.3.2. These stages are discussed in more detail in the following sections.

Scoping

4.3.3. Scoping will determine the environmental topics that should be 'scoped out' of the EIA. The appropriate level of assessment, namely whether a Simple or Detailed assessment

as defined in LA 101, that should be applied to the environmental topics 'scoped in' will be set out.

Defining the Study Area

4.3.4. Study areas are defined individually for each environmental topic, according to the geographic scope of the potential impacts relevant to that topic or of the information required to assess those impacts. It will also draw on guidance in DMRB where this specifies the extent of study areas. The study areas are defined within each relevant topic chapter of this report.

Establishment of Baseline Conditions

4.3.5. The existing baseline conditions need to be defined to allow the assessment of changes that would be caused by the Scheme. The identification of the baseline requires the description of the existing situation and then a prediction of how it is likely to change in the absence of the Scheme.

4.3.6. The description of the baseline conditions should clearly identify receptors that may be affected by the Scheme and also their 'value' or 'sensitivity' to potential change.

Consideration of Alternatives

4.3.7. The ES will include consideration of alternatives, summarising the reasoning behind the Scheme selection, as well as options considered in the design development, as required by the EIA Regulations 2017. This will outline details of why the proposed design has been brought forward to the outline design stage, why alternatives have been rejected.

Consultation

4.3.8. Details on the consultation undertaken to date and planned future consultation as part of the relevant regulatory process can be found in the Statement of Community Consultation document, produced separately from this Scoping Report.

4.3.9. Consultation will be undertaken with both statutory and non-statutory bodies, together with public consultation prior to submission of the DCO Application. Consultation will take place at the Scoping stage and will continue throughout the EIA process to inform the design, agree assessment methodology, and proposed mitigation options.

Identification of Potential Effects

4.3.10. Schedule 4 of the EIA Regulations 2017 requires:

4.3.11. 'A description of the likely significant effects of the development on the environment resulting from, inter alia:

- *The construction and existence of the development;*
- *the use of natural resources, in particular land, soil, water and biodiversity;*
- *the emission of pollutants, noise, vibration, light, heat and radiation, the creation of nuisances, and the disposal and recovery of waste;*
- *the risks to human health, cultural heritage or the environment (for example due to accidents or disasters);*
- *the cumulation of effects with other existing and/or approved projects;*
- *the impact of the project on climate and the vulnerability of the project to climate change; and*
- *the technologies and the substances used.*

4.3.12. The description of the likely significant effects should cover the direct effects and any indirect, secondary, cumulative, transboundary, short-term, medium-term and long-term, permanent and temporary, positive and negative effects of the development.'

4.3.13. A range of environmental topics may be affected by the Scheme. Effects may be negative or positive, temporary or permanent. They may also be described as:

- Direct or Primary Effect: caused by activities which are an integral part of the proposals resulting in a change in environmental conditions, such as construction works causing an increase in dust concentrations in the air;
- Indirect or Secondary Effects: due to activities that affect environmental conditions or the receptors, which in turn affects other aspects of the environment or receptors;
- Cumulative: comprising multiple effects from different sources within the proposals (intra-Scheme), or cumulatively with other developments (inter-project), on the same receptors; and
- Residual: effects that remain after the positive influence of mitigation measures are taken into account.

4.3.14. Each of these effects can persist over a period of time and can be considered as:

- Short term: effects that would last for a limited duration, for example, noise generated during construction of the Scheme; and
- Long term: permanent effects from the operational activities on the Scheme.

Assessment of Signficance

4.3.15. The significance of an environmental effect is typically a function of the 'value' or 'sensitivity' of the receptor and the 'magnitude' or 'scale' of the impact. Combining the environmental value of the resource or receptor with the magnitude of change produces a significance of effect category. In arriving at the significance of effect, the assessor also considers whether the effect is direct, indirect, secondary, cumulative, short, medium or long-term, permanent or temporary, positive or negative.

4.3.16. The proposed general approach will be adopted in accordance with relevant guidance and best practice. Methods and requirements specific to each assessment topic are set out in the relevant topic chapters (Chapters 5 to 14).

4.3.17. With the receptors identified and their sensitivity classified, the potential impacts of the works to these aspects, for construction and operation where appropriate, will be determined and the magnitude of the impact determined.

4.3.18. In accordance with guidance in DMRB LA 104, for each topic the assessment will combine the magnitude of the impacts and the sensitivity of the resources/receptors that could be affected in order to classify the effect (see Table 4-1) and to establish their significance (from very large to neutral). In general terms it is generally accepted that effects which are moderate or higher are deemed significant in assessments. General descriptors for the significance of effect are provided in Table 4-2.

Table 4-1 - Significance Matrix

Sensitivity of receptor	**Magnitude of impact**				
	Major	Moderate	Minor	Negligible	No change
Very high	Very large	Large or very large	Moderate or large	Slight	Neutral
High	Large or very large	Moderate or large	Slight or moderate	Slight	Neutral
Medium	Moderate or large	Moderate	Slight	Neutral or slight	Neutral
Low	Slight or moderate	Slight	Neutral or slight	Neutral or slight	Neutral
Negligible	Slight	Neutral or slight	Neutral or slight	Neutral	Neutral

Table Source: DMRB LA 104 Environmental assessment and monitoring Table 3.8.1

Table 4-2 - Significance categories and typical descriptions

Value	Typical descriptors
Very Large	Effects at this level are material in the decision-making process.
Large	Effects at this level are likely to be material in the decision-making process.
Moderate	Effects at this level can be considered to be material decision-making factors.
Slight	Effects at this level are not material in the decision-making process.
Negligible	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

Table Source: DMRB LA 104 Environmental assessment and monitoring Table 3.7

Defining Assessment Years

Scheme phases

4.3.19. The EIA wll include consideration of effects arising from the construction and operation of the Scheme. Decommissioning is not relevant for the Scheme as noted above.

Do-minimum and Do-something scenarios

4.3.20. The assessment of effects involves comparing a scenario with the Scheme against one without the Scheme over time. The absence and presence of the Scheme are referred to as the 'Do-Minimum' and 'Do-Something' scenarios respectively. Dependent upon the topic, the scenarios will be assessed in the baseline year and a future assessment year or a series of future assessment years (for example 15 years after opening, or the worst year in the first 15 years of operation).

4.3.21. Identification of the baseline requires first the identification of the existing situation, and then the prediction of how it is likely to change between now and implementation of the Scheme.

Dealing with uncertainty

4.3.22. EIA is an iterative process, and the Scheme may include somewhat uncertain aspects. At the time that the EIA is submitted, it is proposed that no aspects of design would vary so much as to represent effectively different schemes. The EIA would ensure it addresses the potential for a range of impacts resulting from any undecided parameters.

4.3.23. The Rochdale Envelope principle would be applied in accordance with the PINS Advice Note Nine using the Rochdale Envelope. The ES will explain clearly any elements of the Scheme yet to be finalised, with justification. Where flexibility is sought in the Scheme design, the maximum potential adverse impacts of the Scheme will be assessed. The ES will confirm maximum and other dimensions of the Scheme, and that any changes to the development within such parameters would not result in significant impacts not previously identified and assessed.

Development of Mitigation Measures

4.3.24. Paragraph 7 of Schedule 4 to the EIA Regulations 2017 requires the EIA to include: "A description of the measures envisaged to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment and, where appropriate, of any proposed monitoring arrangements".

4.3.25. Environmental assessment and design shall incorporate mitigation measures using a hierarchical system as follows, defined in DMRB LA 104:

- *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*.

4.3.26. The environmental assessment and design will incorporate embedded mitigation and essential mitigation. DMRB LA 104 defines embedded mitigation as '*project design principles adopted to avoid or prevent adverse environmental effects*' and essential mitigation as '*measures required to reduce and if possible offset likely significant adverse environmental effects, in support of the reported significance of effects in the environmental assessment*.'

4.3.27. Embedded mitigation will be reported in the project description. Essential mitigation will include Best Practicable Measures, construction environmental management procedures identified in the Construction Environmental Management Plan (CEMP) and will also describe design features that have been adapted to reduce or prevent impacts, such as noise attenuation measures. Essential mitigation is included within the assessment. Enhancement measures, measures over and above normal mitigation, will also be inlcuded within the assessment.

4.3.28. During the Option Selection Stage the need for eliminating or mitigating any adverse environmental impacts were considered. No specific mitigation measures were identified at this stage as they would be developed fully during this Preliminary Design Stage. Where possible, consideration will be given to reducing or avoiding adverse environmental impacts and these will be developed during the Scheme development as an iterative process. Where mitigation measures are required, these will be informed by survey data being collected for the purposes of the Preliminary Design Stage and developed in consultation with statutory bodies. The Scheme will include all mitigation considered necessary to reduce effects to an acceptable level and the assessment will report on this basis. As well as mitigation the Scheme will also include compensation for adverse effects where necessary and again the assessment will be based on the Scheme with this included.

4.3.29. During construction, the responsibility for further environmental mitigation and the adherence to environmentally responsible working practices will fall to the contractor. A CEMP will be prepared by the designer (Atkins) during the PCF Stage 3 and refined as the Scheme progresses to construction and handover. The CEMP will detail practices that the contractor is to apply on site that will demonstrate commitments to environmental management. It will detail both generic and specifically targeted practices to enable construction to be undertaken with minimal impact on the environment and will also enable monitoring requirements to be set up.

Prediction of Residual Environmental Effects

4.3.30. The residual effect will be assessed using the same system as described above to include the mitigation proposed. The residual effect as classified will be considered for its significance. Generally, effects considered to be moderate, large or very large are deemed significant; and those slight or negligible are deemed to be not significant, based on the described classification (Table 4-2) and professional judgement.

Cumulative Impact Assessment

4.3.31. Paragraph 5 of Schedule 4 to the EIA Regulations 2017 requires an ES to include the assessment of cumulative effects. In accordance with the guidance within DMRB LA 104, the environmental effects of the Scheme will also be assessed as part of the EIA process, exploring cumulative effects across topics and upon receptors where the effects of the Scheme may act in combination with the effects of other projects as part of the EIA process, where relevant information is available.

4.3.32. Beyond the reference to "existing and/or approved" projects in paragraph 5, what projects that should be considered as part of a 'cumulative' assessment for these purposes is not defined in the EIA Directive or EIA Regulations 2017 and there is no standard approach to the assessment of cumulative effects, with different projects adopting different

approaches. However, potential cumulative impacts with other major developments need to be identified, as required by the Directive. To aid in this, the PINS Advice Note 17 suggests the categories of developments that should be included in such cumulative assessments. DMRB LA 104 also addresses the assessment of cumulative effects and states that the assessment should include roads projects that have been confirmed for delivery over a similar timeframe; other development projects with valid planning permissions or consent orders, and for which EIA is a requirement; and proposals in adopted development plans with a clear identified programme for delivery.

4.3.33. The Cumulative Impact Assessment (CIA) will explore the way in which the predicted effects of the Scheme on receptors/resources may alter when they are considered in their totality (i.e. across all topic assessments), as well as in the context of Reasonably Foreseeable Future Projects (RFFPs) that could potentially interact with the Scheme. For the purposes of this project, these two strands of CIA are referred to as intra-Scheme assessment and inter-project assessment, respectively.

4.3.34. The CIA will make use of two future baselines for the Scheme to be considered against, making informed assumptions to categorise the likely progression of RFFPs for the purposes of consistent assessment:

- Opening year future baseline (2025): RFFPs may be categorised as 'undeveloped'; or 'under construction' in the same timeframe as the opening of the Scheme; or form new 'receptors/resources' that would be in place and operational in the same timeframe as the opening of the Scheme.
- Operational future baseline (2039): RFFPs may be anticipated to be 'under construction' in the same timeframe as the future baseline; or form new 'receptors/resources' that would be in place and operational.

4.3.35. The consideration of the cumulative impacts is drawn together on the basis of receptors and/or biophysical features deemed likely to experience effects as a consequence of cumulative impacts, whether intra-Scheme or inter-project or, potentially, both. The sensitivity of a receptor or biophysical feature to cumulative impacts and the magnitude of incremental impacts (combining to become cumulative impacts) themselves will determine the significance of the cumulative effect or effects.

4.3.36. This section provides a basic introduction to the way CIA will be approached and reported within the ES for the Scheme. The full proposed methodology is provided in Chapter 15.

Intra-Scheme Assessment

4.3.37. Intra-Scheme impacts are defined as those arising within this Scheme and affecting specific receptors and/or biophysical resources. This requires consideration of the potential for in-combination impacts to emerge within the same specialist topic, as well as reviewing the interaction between impacts identified by each of the specialist topics undertaking assessment of the Scheme.

4.3.38. It is anticipated that within the ES, topic chapters will report on individual receptors/resources predicted to experience multiple topic-specific effects and comment on their likely significance (i.e. intra-Scheme cumulative effects within a specialist topic). A separate CIA summary section would then be produced to report on intra-Scheme cumulative effects that have been identified for receptors/resources predicted to experience significant effects either within a specialist topic, and/ or in relation to more than one specialist topic (referred to as 'cross-topic').

Inter-project Assessment

4.3.39. Inter-project impacts are those arising between the Scheme and other developments expected to come forward within similar timeframes. This requires consideration of the impacts of the Scheme in the context of the RFFP list that will be defined for the Scheme. The methodology in Chapter 15 provides further information about the production of the RFFP list.

4.3.40. Within the ES, it is anticipated that individual topic chapters will identify which of the RFFPs are considered relevant to the assessment. Where inter-project cumulative effects are

predicted in relation to a specialist topic, these are to be reported within the topic chapters, providing an indication of potential significance. A separate CIA summary section will be produced, if necessary, to address inter-project effects that have been identified for receptors/resources predicted to experience significant effects from the Scheme and at least one RFFP, either within a specialist topic, and/or in relation to more than one specialist topic (referred to as 'cross-topic').

Transboundary Impacts

4.3.41. Regulation 32 of the EIA Regulations 2017 requires PINS to notify European Economic Area (EEA) States and publicise an application for development consent if it is of the view that the proposed development is likely to have significant effects on the environment of an EEA Member State, and where relevant to consult with the EEA State affected. The Scheme is approximately 250 km from France, the closest EEA State.

4.3.42. The study areas for the various environmental topics define the extent of effects anticipated and are described fully in Chapter 5 to 14 and are summarised below as follows:

- Air Quality: within 200 m of the works;
- Noise and Vibration: 600 m from the carriageway of the works;
- Biodiversity: 2 km for statutory and non-statutory designated sites and 30 km for SACs;
- Road Drainage and the Water Environment: 1 km around the works;
- Landscape and Visual: within the zone of visual influence of the works, i.e. areas where the Scheme can be seen from;
- Geology and Soils: 500 m from the extent of the works;
- Cultural Heritage: 500 m from the works or within the area considered to be the setting of the asset;
- Materials and Waste: waste arisings within the county of Gloucestershire; and
- People and Communities: 500 m from the works.

4.3.43. The study areas will cover the area where direct effects of the Scheme will be experienced as well as the area where effects on the setting of an asset might be felt, for example the setting of a listed building where the surroundings contribute to its historic value.

4.3.44. For some topics the effects of the Scheme would extend beyond the immediate area of the works. For example, the noise and air quality effects would be experienced in the surrounding area where there would be changes in traffic flows as a result of the Scheme. The method for establishing the extent of study areas in this situation is set out in the topic chapters below.

4.3.45. As none of these distances reach EEA Member States, no transboundary effects are anticipated for the Scheme.

Habitat Regulations Screening

4.3.46. The nearest European designated site to the Scheme is Walmore Common Special Protection Area (SPA) located 17.5 km south west of the Scheme. Further details regarding this site and its qualifying interests are provided in Chapter 7 Biodiversity.

4.3.47. In accordance with the requirements of PINS Advice Note Ten: Habitats Regulations Assessment relevant to nationally significant infrastructure projects, screening for likely significant effects will be undertaken (alone or in-combination with other projects).

4.3.48. Based on current information and the Options Selection Stage Habitat Regulations Assessment (HRA) Screening Matrix it is considered not likely that the Scheme could give rise to impacts on any European Sites, either for the Scheme alone, or in combination with other plans or projects.

4.3.49. Further work during the assessment stage will be undertaken to determine the effects of the Scheme including continuing surveys of bird populations, recording of existing noise

levels, prediction of noise levels, assessment of likely disturbance and mitigation measures.

Equalities Impact Assessment

4.3.50. An EqIA which reports the effect of the Scheme on different social groups will be produced as part of the application and reported separately to the ES.

Major accidents and disasters

4.3.51. In line with the requirements for major accidents and disasters outlined in the EIA Regulatons 2017, the ES will consider:

- Vulnerability of the Scheme to risks of major accidents and/or disasters; and
- Any consequential changes in the predicted effects of the Scheme on environmental topics.

4.3.52. In considering these elements of vulnerability, the ES will:

- Apply professional judgement in consultation with the Overseeing Organisation to develop Scheme specific definitions of major events. It should be noted that there is no definition of 'major' in this context;
- Identify any 'major' events that are relevant to and can affect the Scheme. Major events shall include both man-made and naturally occurring events. Not all events warrant assessment and evidence should be provided to support the view that they should be classified as major events;
- Where Major events are identified, describe the potential for any change in the assessed significance of the Scheme on relevant environmental topics in qualitative terms. Report the conclusions of this assessment within the individual environmental topics; and
- Clearly describe any assumed mitigation measures, to provide an evidence base to support the conclusions and demonstrate that likely effects have been mitigated/managed to an acceptable level.

4.3.53. Major events are reported within the relevant environmental topic chapters.

Environmental Management

4.3.54. A Construction Environmental Management Plan (CEMP) will be prepared by the designer (Atkins) in association with Highways England's contractor delivery partner during this stage and refined as the Scheme progresses from development to construction and handover. The CEMP will detail practices that the contractor is to apply on site that will demonstrate commitments to environmental management. It will detail both generic and specifically targeted practices to enable construction to be undertaken with minimal impact on the environment and will also enable monitoring requirements to be set up. Proposals for monitoring will be developed as part of the topic impact assessments in the ES.

5. Air Quality

5.1. Introduction

5.1.1. This chapter provides the environmental scoping assessment of the Scheme for air quality. This scoping assessment has been based on the air quality assessment presented in the PEAOR that was completed at PCF Stage 2.

5.1.2. The Scheme has the potential to alter vehicle flows on the road network which may change air quality pollutant concentrations at sensitive receptors. As demonstrated in the PCF Stage 2 PEAOR, changes to vehicle flows are likely to exceed commonly adopted air quality assessment screening levels. Detailed consideration of impacts is included within the scope of the PCF Stage 3 EIA.

5.2. Study Area

5.2.1. The Scheme is situated within the administrative boundaries of CBC and TBC.

5.2.2. A provisional assessment study area was determined and presented in the PCF Stage 2 PEAOR report based on traffic data provided as part of the HIF scheme. For the EIA, the study area will be redefined based upon revised Scheme specific traffic data from the updated strategic traffic model for the option taken forward for EIA consideration.

5.2.3. The air quality study area for assessment of both construction traffic and during the operational phase will be determined in accordance with traffic change criteria set out in the EPUK/IAQM Planning Guidance[11] screening criteria, which define the affected road network (ARN) used for further consideration of the impact of changes in traffic emissions the air quality assessment.

5.2.4. The EPUK/IAQM screening criteria for vehicle flows are as follows:

- a change in flows of light duty vehicles (LDV) of more than 500 annual average daily traffic (AADT) (or more than 100 AADT within or adjacent to an AQMA); or
- a change in flows of heavy duty vehicles (HDV) of more than 100 AADT (or more than 25 AADT within or adjacent to an AQMA).

5.2.5. The screening criteria will be applied separately to road links within or adjacent to the CBC AQMA boundary and areas which are distanced from the AQMA designation, such as adjacent to the M5 Junction 10 itself. All new or modified Scheme links (including any realignment or dualing of existing links) will also be included in the ARN.

5.2.6. The ARN identifies where traffic changes on assessed road links may be sufficient to cause a change (increase or decrease) in local air pollutant concentrations during operation of the Scheme.

5.2.7. Based upon the study area defined in the PCF Stage 2 PEAOR study, the local air quality study area covers the majority of the CBC administrative boundary and extends into the TBC and Gloucester City Council areas.

5.3. Planning policy and topic legislative context

UK Air Quality Legislation

5.3.1. There are two sets of air quality legislation which include ambient air quality thresholds for the protection of public health that apply in England:

- legally binding, mandatory limit values originally set by the European Union (EU)

[11] Environmental Protection UK and Institute of Air Quality Management (2017), 'Land-Use Planning & Development Control: Planning for Air Quality', http://iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf

Directive 2008/50/EC[12] on ambient air quality and cleaner air for Europe; and

- regulations implementing national air quality objectives as set out in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland (AQS)[13] which local authorities are required to work towards achieving.

Air Quality Limit Values

5.3.2. The EU (Withdrawal Agreement) Act 2020 sets out arrangement for implementing air quality limit values that are included in the EU Directive on ambient air quality and cleaner air for Europe (2008/50/EC), included in Air Quality Regulations (SI 2010 No.1001)[14] and as amended (SI 2016 No.1184)[15]. The Air Quality (Amendment of Domestic Regulations) (EU Exit) Regulations 2019 (SI 2019 74)[16] and the Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020 (SI 2020 1313)[17] amend the Air Quality Regulations (SI 2010 No.1001) to account for EU withdrawal. The AQS objectives are implemented in the Air Quality (England) Regulations 2000 (SI 2000/928)[18] and Air Quality (England) (Amendment) Regulations 2002 (SI 2002/3043)[19].

5.3.3. The relevant limit values in the context of this assessment for the protection of human health for NO_2 and fine particulate matter are presented in Table 5-1.

5.3.4. Responsibility for achieving the national air quality criteria lies with the Government, although local authorities should contribute to this through local action plans designed to reduce pollution levels in Air Quality Management Areas (AQMAs), and through the recent targeted feasibility studies, including clean air zones where appropriate, to supplement the Government's air quality plan for nitrogen dioxide in the UK[20].

National Air Quality Strategy

5.3.5. The 2007 Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland[21] (UK AQS) sets out the national air quality standards and objectives for a number of local air pollutants. The standards are set by expert organisations with regard to scientific and medical evidence on the effects of the particular pollutant on health and define the level of pollution below which health effects are expected to be minimum or low risk even for the most sensitive members of the population. The objectives are targets for air pollution levels to be achieved by a specified timescale, which take account of the costs and benefits of achieving the standard, either without exception or, for certain short-term averaging period standards, with a permitted number of exceedances. Local authorities have a responsibility (under Part IV of the Environment Act 1995, see below) to review and assess local pollution levels against these objectives. These criteria are defined in Regulations SI 2000 No. 928 and SI 2002 No. 3043.

[12] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe Available at: https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A32008L0050 [Accessed March 2021]
[13] Defra (2011). The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. Available from; https://www.gov.uk/government/publications/2010-to-2015-government-policy-environmental-quality/2010-to-2015-government-policy-environmental-quality#appendix-5-international-european-and-national-standards-for-air-quality [Accessed February 2021].
[14] The National Archives (2010). The Air Quality Standards Regulations 2010. Available from: http://www.legislation.gov.uk/uksi/2010/1001/contents/made [Accessed February 2021].
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[16] The Air Quality (Amendment of Domestic Regulations) (EU Exit) Regulations 2019 (legislation.gov.uk). Available from: https://www.legislation.gov.uk/uksi/2019/74/contents/made [Accessed February 2021]
[17] The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020 (legislation.gov.uk). Available From: https://www.legislation.gov.uk/uksi/2020/1313/contents/made [Accessed February 2021]
[18] The National Archives (2000).The Air Quality (England) Regulations 2000.Available from: http://www.legislation.gov.uk/uksi/2000/928/contents/made [Accessed February 2021].
[19] The National Archives (2002).The Air Quality (England) (Amended) Regulations 2002.Available from: http://www.legislation.gov.uk/uksi/2002/3043/contents [Accessed February 2021].
[20] DEFRA, UK plan for tackling roadside nitrogen dioxide concentrations, July 2017, Available at: https://uk-air.defra.gov.uk/library/no2ten/index [Accessed February 2021]
[21] Department for Environment, Food and Rural Affairs (DEFRA), 2007. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. http://archive.Defra.gov.uk/environment/quality/air/airquality/strategy/documents/air-qualitystrategy-vol1.pdf

5.3.6. It should be noted that the UK AQS objectives only apply in locations likely to have 'relevant exposure' i.e. where members of the public are exposed for periods equal to or exceeding the averaging periods set for the standards. For this assessment, locations of relevant exposure include building façades of residential premises, schools, public buildings and medical facilities; places of work (other than certain community facilities) are excluded.

5.3.7. In January 2019, the UK Government published its Clean Air Strategy[22], which sets out actions proposed by the Government to improve air quality by reducing pollution from a wide range of sources. Within the strategy, the Government sets an ambitious target to reduce the population exposed to concentrations of PM2.5 above 10 µg/m^3 by 50% by 2025.

Local Air Quality Management

5.3.8. Under Part IV of the Environment Act 1995 all local authorities are responsible for Local Air Quality Management (LAQM), the mechanism by which the Government's AQS objectives are to be achieved. As part of this LAQM role, local authorities are required to periodically review air quality in their area and to assess present and likely future air quality against the objectives defined in Regulations. Where a local authority anticipates an objective is expected to be breached within their area, they must designate an AQMA and develop an action plan to improve pollution levels and work towards achieving the AQS objectives. Under the current LAQM regime, a local authority is responsible for regular review and assessment of local air quality, reports on which are published following public consultation and review by the Department for Environment, Food and Rural Affairs (DEFRA).

5.3.9. Statutory responsibility for achieving air quality limit values rests with the Secretary of State and local authorities have no responsibility for achieving the national air quality criteria, although they should contribute to this through local action plans designed to reduce pollution levels in AQMAs.

5.3.10. The relevant air quality criteria for the protection of human health are outlined in Table 5-1.

Table 5-1 - Relevant Air Quality Criteria

Pollutant	Objective
NO_2	Hourly mean concentration should not exceed 200 µg/m^3 more than 18 times a year Annual mean concentration should not exceed 40 µg/m^3
PM_{10}	24-hour mean concentration should not exceed 50 µg/m^3 more than 35 times a year Annual mean concentration should not exceed 40 µg/m^3
$PM_{2.5}$	UK (Except Scotland) annual mean concentration should not exceed 25 µg/m^3† Exposure reduction^ (UK urban areas): target of 15% reduction in concentrations at urban background between 2010 and 2020*
† UK AQS objective is 25 µg/m^3 to be met by 2020. Limit value is 25 µg/m^3 to be met by 2015, with a requirement in urban areas to bring exposure down to below 20 µg/m^3 by 2020. ^ Limit value exposure reduction target of 20% reduction between 2010 and 2020. * 25 µg/m^3 is a cap to be seen in conjunction with 15% reduction.	

[22] DEFRA, 2019. Clean Air Strategy 2019. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/770715/clean-air-strategy-2019.pdf.

National Policy

National Policy Statement for National Networks (NN NPS, 2014)

5.3.11. The Scheme falls within the definition of an NSIP, making the NN NPS the primary planning policy against which an application for a development consent order (DCO) for the Scheme would be judged.

5.3.12. Paragraphs 5.3 – 5.15 relate to air quality assessment of transport schemes. Paragraph 5.11 states "Air quality considerations are likely to be particularly relevant where schemes are proposed: within or adjacent to AQMAs; roads identified as being above Limit Values or nature conservation sites; and where changes are sufficient to bring about the need for a new AQMA or change the size of an existing AQMA; or bring about changes to exceedances of the Limit Values, or where they may have the potential to impact on nature conservation sites."

5.3.13. Paragraph 5.12 states that air quality considerations must be given substantial weight where a project would lead to a significant air quality impact and/or lead to a deterioration in air quality in a zone/agglomeration.

5.3.14. Paragraph 5.13 of the NN NPS is particularly relevant and sets out that the Secretary of State should refuse consent, if including mitigation measures, the Scheme will 'result in a zone/agglomeration which is currently reported as being compliant with the Air Quality Directive becoming non-compliant.' Furthermore, consent should be refused where air quality impacts will 'affect the ability of a non-compliant area to achieve compliance within the most recent timescale reported to the European Commission at the time of the decision'

National Planning Policy Framework (NPPF, 2019)

5.3.15. Given that the Scheme is an NSIP, the NPPF has the status of a material consideration in planning terms.

5.3.16. Paragraph 103 states that growth and development should be focused on locations which can be made sustainable. This includes reducing congestion, emissions and improving air quality and public health.

5.3.17. Paragraph 181 concerns the need to take into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. The paragraph goes on to state that any new development in Air Quality Management Areas should be consistent with the local air quality action plan.

5.3.18. Building on the NPPF, planning practice guidance on air quality provides guiding principles on how planning can take account of the impact of new development on air quality.

Regional Policy

Gloucestershire Local Transport Plan 2020–2041

5.3.19. LTP PD 4.9 – Environment states that the County Council will work with District Councils to improve air quality on the highway network. This will be achieved through developing, adopting and delivering 'Air Quality Action Plans required where Air Quality Management Areas have been declared, in relation to transport emissions.

Local Policy

Gloucester, Cheltenham and Tewkesbury Joint Core Strategy 2011-2031

5.3.20. Policy SD3 Sustainable Design and Construction states that proposals should demonstrate how they contribute to the aims of sustainability by a number of factors, including the unnecessary pollution of air.

5.3.21. Policy SD14 Health and Environmental Quality states that development should protect and seek to improve environmental quality through development resulting in no unacceptable levels of air pollution.

5.3.22. Strategic Objective 9 – Promoting healthy communities outlines the stance that a healthy population will be maintained through 'ensuring that environmental quality and air quality is protected.'

Cheltenham Borough Council Local Plan 2011-2031 – Adopted July 2020

5.3.23. No borough wide air quality specific policies are included. Location specific guidance is provided for the protection of the Beechwoods Special Area of Conservation (SAC) as below:

5.3.24. Policy BG2: Cotswold Beechwoods SAC air quality development - Development which is likely to generate additional road traffic emissions to air which are capable of affecting the Cotswold Beechwoods SAC will be screened against the Habitats Regulations Assessment Framework in line with Natural England's guidance 'Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations (NEA001)'"

Tewkesbury Borough Local Plan – Saved Policies (2011)

5.3.25. Policy EVT4: Air Quality states that 'appropriate measures should be taken to ensure there is no risk to public health from the release of airborne pollutants'

Gloucester City Council Local Plan – Saved Policies (2002)

5.3.26. Policy FRP.11 Pollution states that 'Development that may be liable to cause pollution of water, air or soil, or pollution through noise, dust, vibration, light, heat or radiation will only be permitted if the quality and enjoyment of the environment would not be unduly damaged or put at risk.

Ecological Criteria

5.3.27. The EU Directive, adopted as part of the UK Withdrawal agreement, sets a critical level for annual mean concentrations of nitrogen oxides (NOx) to protect sensitive vegetation. This is included in the Air Quality Standards Regulations. Assessment of compliance with this critical level is undertaken at locations more than 20 km from towns with more than 250,000 inhabitants or more than 5 km from other built-up areas, industrial installations or motorways or major roads with traffic counts of more than 50,000 vehicles per day. This objective does not apply in those areas where assessment of compliance with the limit value is not required. For this study, the criterion of 30 $\mu g/m^3$ was applied on a precautionary basis to all ecological sites included in the assessment.

5.3.28. Critical loads for nitrogen deposition have been set by the United Nations Economic Commission for Europe. A critical load is a quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur, according to present knowledge. Critical loads vary by type of habitat and species. The critical load for deposition (eutrophication) is given as a range and is quoted in units of kg/ha/year, however the lower value of the critical load range is typically used in assessment.

Dust Deposition

5.3.29. There are no national standards or guidelines for dust deposition currently set for the UK, nor by the European Union or any international organisation. This is mainly due to the difficulty in setting a standard that needs to relate to dust being a perceptual problem rather than being specifically related to health effects. Typically, assessments use an indicative threshold for the 'likelihood of complaint' for instance, in residential areas a dust deposition flux (as an average measured over a month using a passive deposition gauge) of 200 $mg/m^2/day$ or greater.

5.4. Baseline Conditions

5.4.1. The Scheme is located within the administrative areas of CBC and TBC.

5.4.2. The air quality study area includes the CBC AQMA 2020 declared September 2020 due to exceedances of the NO_2 annual mean AQS objective. The AQMA comprises High Street from junction of Gloucester Road and Tewkesbury Road to junction of Burton Street, Poole Way and Swindon Road from junction of Poole Way to St Georges Street.

5.4.3. This designation replaces the CBC borough wide AQMA. The AQAP is proposed to be updated following completion of consultation on the AQMA amendments. Further details on the revised AQMA will be confirmed by CBC in due course.

5.4.4. TBC declared one AQMA in 2008 encompassing individual roads within Tewkesbury town centre. This AQMA is located approximately 5 km north west of the Scheme.

5.4.5. A summary of the AQMAs is presented in Table 5-2.

Table 5-2 - AQMAs declared by CBC and TBC in proximity to the Scheme

Name	AQ Criteria Exceeded	Description
Cheltenham Whole Borough AQMA	Annual mean nitrogen dioxide NO_2	High Street from junction of Gloucester Road and Tewkesbury Road to junction of Burton Street, Poole Way and Swindon Road from junction of Poole Way to St Georges Street
Tewkesbury Town Centre AQMA	Annual mean nitrogen dioxide NO_2	An area encompassing parts of Tewkesbury town centre, including parts of High Street, Barton Street Church Street and the Eastern Relief Road.

SOURCE: https://uk-air.defra.gov.uk/aqma/

Continuous Monitoring

5.4.6. Air quality monitoring is undertaken at a national and local authority level and is a key component of local air quality management. Measurements of pollutant concentrations include analytical instruments that measure continuously, and simpler sampling devices such as diffusion tubes which give longer period results (typically monthly, to calculate an annual mean concentration).

5.4.7. The nearest Continuous Monitoring Station (CMS) to the Scheme is located at St Georges Street, in Cheltenham town centre approximately 5 km southeast of the location of the current M5 Junction 10. The CMS monitors concentrations of NO_2, as shown in Table 5-3.

5.4.8. The monitored values show that NO_2 concentrations as an annual mean approach but do not exceed the AQS objective of 40 µg/m^3. There were no reported exceedances of the short-term hourly objective of 200 µg/m^3 between 2015 and 2019

5.4.9. In 2020 CBC plan to install additional monitoring using AQMesh pods, which will monitor for NO_x and $PM_{2.5}$ at nine locations. The installation process has been delayed due to the lockdown period in 2020.

Table 5-3 - Annual mean NO_2 concentrations - CMS monitoring results (µg/m^3)

Site ID	Site Name	Site Type	X	Y	2015	2016	2017	2018	2019
CM1	St Georges Street	Kerbside	394760	222878	35.0	34.0	36.0	32.7	36.0

Passive Monitoring

5.4.10. Annual mean NO_2 concentrations are also measured by both CBC and TBC using passive diffusion tubes. There are several diffusion tubes located in the proximity of the Scheme. Concentrations of NO_2 measured at the closest diffusion tube locations to the Scheme are presented below in Table 5-4.

5.4.11. The diffusion tube results show that NO_2 concentrations at roadside locations approach and in some cases exceed the annual mean AQS objective of 40 µg/m^3. The data shows a general improvement in conditions with a reduction in the number of locations exceeding the 40 µg/m^3 annual mean objective between 2015 (where six out of 18 sites exceeded) and 2019 (where three out of 31 sites exceeded).

5.4.12. It is notable that the locations with NO_2 concentrations exceeding the 40 µg/m^3 annual mean NO_2 objective in 2017, 2018 and 2019 (Site ID 4, 5 and 6) were along the northern access routes to northern areas of Cheltenham town centre, A4019 High Street and Swindon Road. These areas, which have relevant areas of public exposure at roadside locations, are likely to be the most sensitive to air quality impacts of the Scheme.

Table 5-4 - NO_2 Diffusion Tube monitoring results (µg/m^3)

Site	Site Name	Type	X	Y	2015	2016	2017	2018	2019
14 N	69 Sussex Gardens	Urban	387915	217389	25.4	26.8	24.7	27	23.6
15 N	Comus Bamfurlong	Urban	389714	221845	28.5	25.6	26.2	27.9	25.7
16 N	15 Withybridge Gardens	Urban	390461	225544	26.5	29	25.7	25.1	22.0
52 N	43 Stocken Close	Roadside	387570	216935	25.1	26.2	25.6	24.2	21.2
55 N	Stokes Road, Bishops Cleve	Roadside	395123	227638	No Data	No Data	No Data	19.0	18.8
1	Municipal Offices (Front)	Roadside	394757	222320	No Data	No Data	26.4	22.9	23.8
2	Municipal Offices (Back)	Roadside	394724	222320	No Data	No Data	32.9	28.0	27.6
3	Ladies College	Roadside	394621	222215	36.6	33.8	32.8	27.5	29.6
4	2 Gloucester Road	Roadside	394235	223055	46.5	43.2	45.4	41.2	43.1
5	422 High St	Roadside	394350	222923	47.3	45.5	49.9	45.2	46.5
6	New Rutland	Roadside	394738	222888	42.4	40.8	41.6	37.9	40.3
7, 8 & 9	Triple Co-location – 1	Roadside	394760	222878	34.6	33.3	36.4	32.9	35.1
10	2 Swindon Road	Kerbside	394830	222845	37.9	38.2	39.4	35.6	39.2
11	Portland Street	Roadside	395110	222670	36.8	35.7	35.9	32.6	34.1
12	Winchcombe/Fairview	Roadside	395210	222618	33	32.2	32.8	31.8	34.4

Site	Site Name	Type	X	Y	2015	2016	2017	2018	2019
13	Albion Street (outside no. 54)	Kerbside	395207	222465	No Data	No Data	34.8	31.3	30.4
14	2 London Road	Roadside	395362	222000	40	38	37.1	37.4	37.4
15	YMCA - High St	Roadside	395182	222183	34.5	32.9	31.9	29.1	28.5
16	8a Bath Road	Roadside	395146	222149	41.1	38.4	38	34.5	34.4
18	81 London Road	Roadside	395660	221670	**41.4**	39.6	38.4	37.3	37.6
19	264 Gloucester Road	Roadside	393296	222170	36.7	32.2	34.4	30.6	33.4
20	340 Gloucester Road	Roadside	392912	221862	38.7	35.9	38.6	35.3	36.2
21	14 Imperial Square	Roadside	394807	222058	No Data	No Data	No Data	23.4	23.9
22	Hatherley Lane	Roadside	391177	221638	No Data	No Data	35.1 *	34.9	33.4
23	St James Square	Roadside	394576	222425	No Data	No Data	29.6 *	30.9	32.6
24	St Gregorys Church	Roadside	394566	222602	No Data	No Data	26.7 *	27.9	25.1
25	St Georges Street	Roadside	394704	222755	No Data	No Data	30.5 *	31.9	31.6
26	St Pauls Road	Roadside	394894	223011	No Data	No Data	27.7 *	29.0	31.3
27	St Lukes College Road	Roadside	395157	221865	No Data	No Data	23.7 *	24.8	27.6
28	Princess Elizabeth Way North	Roadside	393077	223644	No Data	No Data	36.7 *	38.4	38.2
29	Princess Elizabeth Way South	Roadside	392055	222527	No Data	No Data	29.8 *	31.2	33.7

*Bold values exceed Annual NO_2 mean concentration of 40 µg/m^3

Project Specific Air Quality Monitoring

5.4.13. A site-specific six-month monitoring survey, conducted between July and December 2019, was conducted to provide baseline pollutant information and Scheme specific monitoring for model verification purposes. The survey comprised ten locations, sampled using passive NO_2 diffusion tubes in triplicate. The locations were selected to provide positions to allow model verification on road links outside the Cheltenham town central urban area and near to the Scheme. With permission of CBC, one of the locations is co-located with the St Georges Street CMS (CMS1), to allow bias adjustment to be conducted using local data.

5.4.14. Annualised and bias-adjusted concentrations over the six months are provided in Table 5-5. A map of the selected locations is presented as Figure 5-1. Roadside locations on principal roads within the AQMA show concentrations approaching 40 µg/m^3 (D1 and D2). All other locations, those outside and those on minor road links within the AQMA, recorded concentrations below 35 µg/m^3.

Table 5-5 - Project Specific NO_2 Diffusion Tube Monitoring Survey – 2019 (µg/m^3)

Location	Description	Grid reference (m)	Annualisation factor	Adjusted annual mean concentration
D1	St George's Street - CMS Co-location	394766, 222871	1.1	38.1
D2	A40 - GCHQ	391716, 222003	1.0	37.9
D3	A4019 - West of M5 Junction 10	389858, 226030	1.1	21.5
D4	Withybridge Gardens	390689, 225439	1.1	24.7
D5	A4019 - Near Homecroft Drive	392182, 224671	1.1	32.4
D6	B4634 - Near to Hayden Lane	390140, 223670	1.1	34.4
D7	B4634 - Near to Pilgrove Way	391790, 224218	1.1	23.0
D8	Withybridge Lane - Withybridge Farm	390464, 224672	1.1	24.4
D9	Lowdilow Lane	391521, 226422	1.1	18.5
D10	Princess Elizabeth Way	392362, 223223	1.1	29.6

Local bias adjustment factor 1.009, based on comparison between CBC CMS1 and site D1

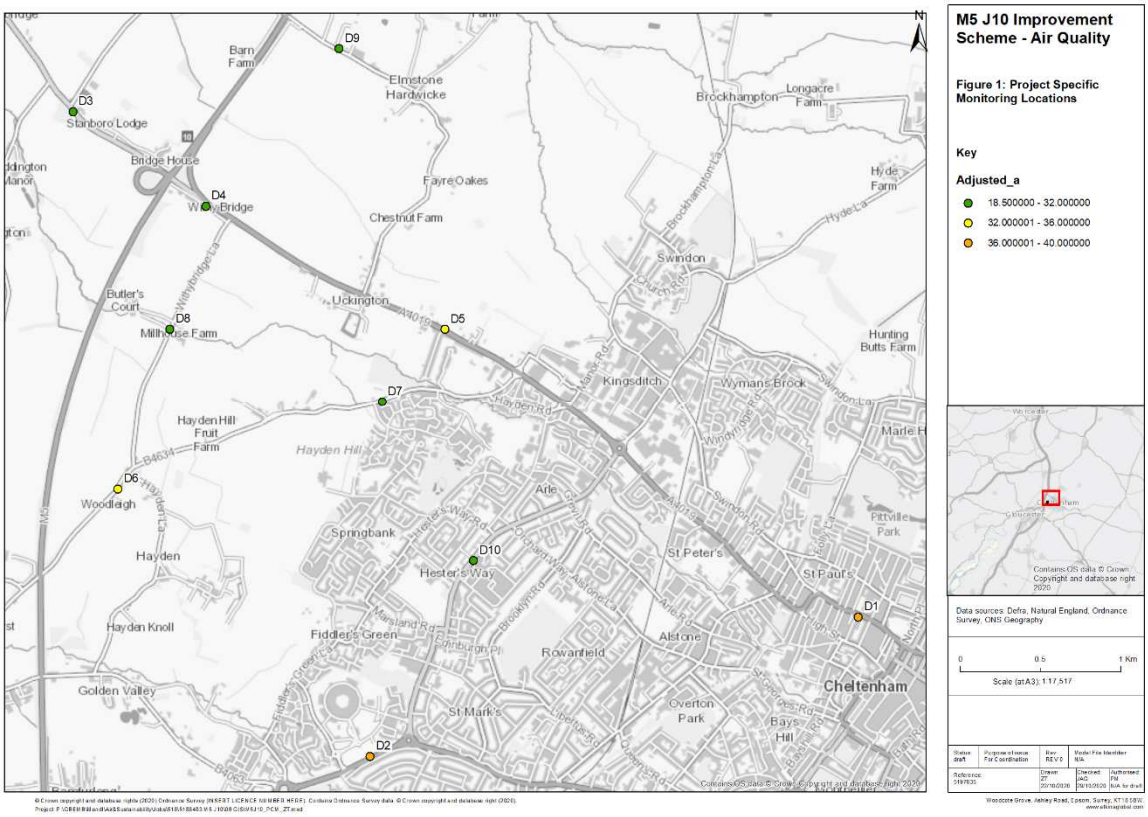

Figure 5-1 - Project Specific Monitoring Locations

Background Mapping

5.4.15. Estimates of background pollutant concentrations in the UK are available on the DEFRA UK-Air website[23]. The background estimates, which are a combination of measured and modelled data, are available for each 1 km grid square throughout the UK for the years 2018 to 2030. The estimated annual average background concentrations in the area covering the Scheme and a 20 x 20 km grid centred upon Cheltenham Town Centre for the baseline year (2019) and the Scheme opening year (2025) are presented in Table 5-6 for the pollutants NO_2, PM_{10} and $PM_{2.5}$.

Table 5-6 - DEFRA mapped background concentrations, 2019 and 2025 (µg/m^3)

Grid Square (x,y)	2019 Background Concentration (µg/m^3)			2025 Background Concentration (µg/m^3)		
	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
Minimum	6.8	12.2	7.9	5.5	11.4	7.2
Maximum	19.6	16.2	10.1	14.8	15.3	9.3

5.4.16. Background concentrations of key pollutants are below relevant AQS objectives in 2019 and 2025.

Compliance with Air Quality Limit Values

5.4.17. DEFRA's PCM model provides estimates of roadside concentrations of annual mean NO_2 and PM_{10}, which have historically been used in reporting to the EU regarding compliance with the limit values. The air quality study area includes a road identified by DEFRA as exceeding the air quality limit value for annual mean NO_2 concentrations. The latest update of the PCM modelling indicates that the air quality limit value was exceeded at roadside locations in 2018 on part of the A40. This part of the A40 is PCM census ID 802077985 running from Arle Court Roundabout to the A4013 at Princess Elizabeth Way Roundabout on the western side of Cheltenham. However, the PCM model estimates that there will be compliance by 2019. The estimated roadside NO_2 concentrations for the A40 is PCM census ID 802077985 link is as follows:

- 2018 - 40.6 µg/m^3
- 2019 - 38.7 µg/m^3
- 2020 - 36.8 µg/m^3
- 2021 - 34.6 µg/m^3

5.4.18. In 2018 DEFRA directed CBC to prepare a 'Targeted Feasibility Study to Deliver Nitrogen Dioxide Concentration Compliance in The Shortest Possible Time'[24]. This document was published on the Air Quality Plan website and was used to prepare DEFRA's Supplement to 'The UK Plan for Tackling Roadside Nitrogen Dioxide Concentrations'. Where the Scheme results in an increase in NO_2 concentrations adjacent to PCM links where an exceedance of the air quality limit value is expected, a compliance assessment may be required to determine the impact the Scheme will have on achieving the air quality limit value.

5.5. Assumptions and Limitations

5.5.1. There were no statutory designated ecological receptors in the vicinity of the air quality study area for the Scheme identified during the option selection process. This conclusion will be reviewed as part of the EIA study which may have a revised ARN.

5.5.2. Significant impacts are not expected and further assessment of air quality impacts on ecological receptors is unlikely to be required.

23 https://laqm.DEFRA.gov.uk/review-and-assessment/tools/background-maps.html

24 Targeted Feasibility Study To Deliver Nitrogen Dioxide Concentration Compliance In The Shortest Possible Time, Cheltenham Borough Council, 2018, Available at https://uk-air.defra.gov.uk/library/assets/documents/no2ten/Cheltenham_FINAL.pdf

5.6. Potential impacts

5.6.1. The Scheme has the potential to affect local air quality, both during construction and once operational.

Construction Phase

Dust Emissions

5.6.2. There is the potential for elevated dust deposition and soiling at properties within 350m of the indicative construction site boundary, in accordance with IAQM[25] guidance, as a consequence of the works, if dust raising activities are not effectively controlled and mitigated. The level and distribution of dust emissions would vary according to the duration and location of activity, weather conditions, and the effectiveness of suppression measures.

5.6.3. An assessment of the potential for construction dust impacts will be conducted at the next assessment stage when a single preferred option is defined.

Construction Traffic

5.6.4. An increase in vehicle movements is expected to occur during the construction period, associated with the transport of materials, plant and labour to and from site. At this stage, the numbers of expected vehicle movements are not yet known, so cannot be quantitatively assessed. It is also not yet known the details of any traffic management or diversions of existing traffic during the construction phase. Any impact would be expected to be less than that during the operational phase and would be temporary. This will be examined further once information on changes in traffic movements is available.

Operational Phase

Scheme and Dependent Development Generated Vehicle Movements

5.6.5. The improved M5 access provided by the Scheme will result in a redistribution of traffic on the existing network in the operational phase. In addition, dependent developments unlocked by the Scheme will also result in an increase in traffic on the road network.

5.6.6. A change in the number, type and speed of vehicles on a link has the potential to change air quality pollutant concentrations at adjacent sensitive receptors. As part of the PCF Stage 2 PEAOR, an initial assessment of affected roads was conducted to allow comparison of the Scheme options considered at that stage of the project. This will be updated for the preferred option, however it was identified that a number of links, including within the CBC AQMA, would result in increases in vehicle flows above the assessment screening criteria and may have the potential to affect air quality pollutant concentrations.

5.6.7. Significant air quality effects are more likely to occur where links with traffic changes are located in an area with currently elevated air quality pollutant concentrations. As such, areas in central Cheltenham, within the AQMA, are likely to be the most sensitive to changes in traffic. Of particular concern are residential receptors adjacent to the A4019 and High Street (north and west of the Cheltenham town centre), where CBC monitoring has shown exceedances of the annual mean NO_2 air quality objective over the last 5 years.

25 IAQM Guidance on the assessment of dust from demolition and construction, Institute of Air Quality Management (2014). www.iaqm.co.uk/text/guidance/construction-dust-2014.pdf, as revised 2016.

5.7. Potential Effects and Mitigation Measures

Construction Phase

Dust Emissions

5.7.1. Application of suitable dust mitigation measures will be applied in accordance with the expected magnitude of dust impacts adjacent to the site boundary and local roads near to construction vehicle access points. With application of suitable mitigation measures, proportional to the risk of impacts, significant impacts at receptor locations are unlikely to occur.

Construction Traffic

5.7.2. No specific mitigation is currently proposed for air quality. Appropriate mitigation measures will be selected based upon the magnitude of any adverse impacts identified during air quality assessment.

Operational Phase

Scheme and Dependent Development Generated Vehicle Movements

5.7.3. No specific mitigation is currently proposed for air quality. Appropriate mitigation measures will be selected based upon the magnitude of any adverse impacts identified during air quality assessment.

5.8. Likely Residual Effects

5.8.1. Construction dust – Residual effects are not expected with adoption of mitigation measures which are proportiante to the expected risk of dust impacts.

5.8.2. Vehicle emissions – there is potential for air quality impacts at locations within the current AQMA designation. The magnitude of any effects will be quantified in the EIA assessment and consideration will be given to mitigation measures. The project may create a conflict with CBC's plan to revoke the AQMA designation at a number of areas within the current designated area.

5.9. Proposed Level and Scope of Assessment

5.9.1. As the ARN reported at PCF Stage 2 included areas where monitoring data indicated AQS objectives were being exceeded and were within an AQMA, a detailed air quality assessment is recommended to be undertaken as detailed in Section 5.10 below.

5.10. Proposed Assessment Methodology

5.10.1. The assessment methodology proposed is as follows:

- Qualitative construction dust assessment in accordance with IAQM guidance[25].
- Where construction traffic data is available further assessment will only be advised where data indicates that traffic changes during construction exceed traffic change criteria in the EPUK/IAQM Planning Guidance[11].
- An operational ARN will be determined based on traffic change screening criteria detailed in the EPUK/IAQM Planning Guidance[11]. These criteria are:
  - a change in flows of LDV of more than 500 AADT (or more than 100 AADT within or adjacent to an AQMA); or
  - a change in flows of HDV of more than 100 AADT (or more than 25 AADT within or adjacent to an AQMA).
- Representative sensitive receptors shall be chosen within 200 m of the ARN and will include residential properties, schools and hospitals, for comparison against

annual mean AQS objectives. The selection will include those receptors with the highest pollutant concentrations (closest to the road, junctions etc.) or anticipated to experience highest level of change (next to roads within the ARN with the largest change in the traffic screening criteria).

- Concentrations at sensitive receptors will be modelled using the ADMS Roads v5 model. Traffic emissions will be based on AADT, %HDV and annual average daily speed, calculated using the latest DEFRA emission factor toolkit. Scenarios modelled are to include:
  - Without the Scheme for the base (current), opening and design year (3 scenarios)
  - With Scheme for opening and design year (2 scenarios)
  - With Scheme and Scheme dependent developments for the opening and design year (2 scenarios)
- A PCM Compliance Risk Assessment will be undertaken at receptors where there is a risk of compliance with the air quality limit value, additional PCM receptors will be included in the air quality model (4 m from kerb and 2 m height), following the method detailed in DMRB guidance LA105[26].
- Modelled road NO_x concentrations will be adjusted using the latest NO_x to NO_2 calculator and all model results will be verified against monitoring results in the base year. Future years will be adjusted by the factor derived in the verification.
- CO_2 and NO_x emissions will be calculated for ARN links only based on DEFRA's latest emission factor toolkit.

5.11. Proposed Consultation

5.11.1. Consultion on the proposed methodology will be undertaken with Gloucestershire County Council and Environmental Health Officers at CBC and TBC.

5.12. Conclusion

5.12.1. The Scheme area is within 350 m of residential areas and a construction dust assessment is recommended to ensure appropriate mitigation measures are recommended for the construction phase.

5.12.2. Where details are available on additional temporary construction traffic or temporary diversions during construction, they will be assessed where there are locations exceeding the traffic change screening criteria in IAQM guidance[11].

5.12.3. The Scheme air quality study area includes at least one AQMA and locations where monitoring data indicate that concentrations at sensitive receptors are currently exceeding the AQS objective for annual mean NO_2. A detailed air quality assessment using a dispersion model is advised to examine the predicted changes in air quality at sensitive receptors as a result of the Scheme.

5.12.4. No sensitive ecological receptors were identified at the previous stage of assessment so further assessment is not recommended.

[26] LA105 – Air Quality, Design Manual for Roads and Bridges – Sustainability and Environmental Appraisal, Highways England, November 2019

6. Noise and Vibration

6.1. Introduction

6.1.1. This chapter provides the environmental scoping assessment of the Scheme for noise and vibration. The chapter sets out the standards and methodologies that will be used to carry out the PCF Stage 3 assessment of noise and vibration. It contains information about the existing and the potential noise constraints, and describes the potential noise and vibration impacts related to the construction and operation of the Scheme.

6.2. Study area

Construction

6.2.1. The study area for the assessment of construction effects from road schemes is defined in the DMRB LA 111, including construction activities, diversion routes, construction traffic and vibration.

6.2.2. The consideration of effects on human receptors during the construction phase will identify sensitive receptors located within 300 m of the edge of the construction works. The study area will be derived using a desktop review of maps and guidance, as set out in BS5228 and DMRB LA 111.

6.2.3. A study area will be required for diversion routes if the project requires full carriageway closures at night (23:00-07:00) to enable construction works to take place. The study area will be defined to include a 25 m strip from the kerb line of the diversion route.

6.2.4. A construction traffic study area will also be defined to include a 50 m strip from the kerb line of the public roads which have the potential to increase the basic noise level (BNL) by 1dB(A) or more as a result of the addition of construction traffic.

6.2.5. If required, the construction vibration study area will be defined as being 100 m from the closest construction activity that generates vibration.

6.2.6. When defined as above, the extent of each study area is normally sufficient to determine the sensitive receptors that are potentially affected, as well as satisfying reasonable stakeholder expectation.

Operation

6.2.7. The study area for the assessment of operational effects is defined in the DMRB LA 111 as 600 m from the carriageway edge of any proposed new road links, or roads physically changed or bypassed by the project.

6.2.8. In addition, the study area includes a 50 m strip from the kerb line of the road links which have the potential to increase the BNL by 1dB(A) or more in the short term, but are not part of the Scheme. A study area defined in this way is normally sufficient to determine the sensitive receptors that are potentially affected, as well as satisfying reasonable stakeholder expectations.

6.2.9. The extent of the study area may be extended based on information from the local authority or based on local concerns known to the project team. Determination of the study area may be constrained by the geographical extent of the traffic model and the Traffic Model Reliability Area made available for the Scheme appraisal.

6.3. Planning Policy and Topic Legislative Context

National Policy

6.3.1. Current noise policy in England is based on the Noise Policy Statement for England (NPSE), which, through the effective management and control of environmental noise within the context of Government policy on sustainable development, aims to:

- Avoid significant adverse effects as a result of the Scheme;
- Mitigate and minimise other adverse impacts on health and quality of life; and
- Contribute to improvements to health and quality of life, where possible.

6.3.2. The Scheme is intended to adhere to the aims of the NPSE. These aims are considered with reference to the policy and guidance contained within the:

- National Policy Statement for National Networks (NN NPS);
  - The Scheme falls within the definition of an NSIP, making the NN NPS the primary planning policy against which an application for a DCO for the Scheme would be judged.
- National Planning Policy Framework (NPPF) 2019;
  - Given that the Scheme is an NSIP, the NPPF has the status of a material consideration in planning terms; and
- Planning Practice Guidance: Noise (PPGN).

6.3.3. The Explanatory Note to the NPSE assists in the definition of significant adverse and adverse with the following concepts:

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

6.3.4. The Scheme has the potential to adversely affect noise and vibration sensitive receptors in the area. DMRB LA 111 notes that the definition of 'Noise Sensitive Receptors' (NSR) is simply 'receptors which are potentially sensitive to noise'. A distinction is also made between 'dwellings' and 'other noise sensitive receptors', which may include:

- Hospitals;
- Healthcare facilities;
- Education facilities;
- Community facilities;
- Environmental Noise Directive (END) quiet areas or potential END quiet areas;
- International and national or statutorily designated sites; and
- Public rights of way and cultural heritage assets.

6.3.5. There are further noise policy documents that may be called upon as required:

- The Control of Pollution Act 1974 (as amended)
- The Environmental Protection Act 1990 (as amended)
- The Control of Noise (Code of Practice for Construction and Open Sites) (England) Order 2015
- Noise Insulation Regulations 1975 (as amended)

Local Policy

6.3.6. The JCS includes a policy relating to noise emissions. Policy SD4 of this document states:

"New development should enhance comfort, convenience and enjoyment through assessment of the opportunities for light, privacy and external space, and the avoidance or mitigation of potential disturbances, including visual intrusion, noise, smell and pollution."

6.4. Baseline Conditions

6.4.1. Information regarding the existing ambient noise climate i.e. baseline conditions, and identification of potential noise impact constraints of the Scheme, will be determined through reference to the following sources:

- Ordnance Survey base mapping to identify locations of residential and non-residential noise sensitive receptors (residential properties, schools, hospitals and elderly care homes);
- DEFRA MAGIC website to identify boundaries of designated ecological sites that may be considered as sensitive to noise;
- Extrium Noise Map Viewer showing DEFRA Noise Important Areas (NIA); and
- Extrium Noise Map Viewer showing DEFRA Strategic Noise Mapping for Environmental Noise Directive (Directive 2002/49/EC) and the Environmental Noise (England) Regulations 2006 (as amended) (2015).

6.4.2. Road traffic noise from the trunk roads in the study area, such as the M5 and A4019, is the dominant source of ambient noise in the study area. The land use within 600 m of the Scheme is mainly agricultural, with clusters of properties located on the outskirts of Cheltenham. There are also areas of land near the Scheme which have been earmarked for almost 9000 properties.

6.4.3. Noise surveys have not been undertaken at an earlier stage of this scheme, but are planned for early Spring 2021 for PCF Stage 3.

6.4.4. At this stage of the project, indicative baseline noise conditions have been determined from the modelled Do Minimum opening year noise levels, predicted as part of PCF Stage 2. This approach is considered appropriate due to road traffic noise being the predominant source within the study areas. All other noise sources have been excluded from the assessment.

6.4.5. Most receptors within the study area have day-time baseline noise levels in the range 40-45 dB $L_{A10,18h}$. Receptors which are close to the motorway have baseline noise levels up to 75 dB $L_{A10,18h}$.

6.4.6. 'Important Areas' for noise were identified to highlight any particular constraints on the Scheme. These are the areas where 1% of the population are affected by the highest noise levels from major roads are located according to the strategic noise mapping undertaken by DEFRA under the terms of the Environmental Noise (England) Regulations 2006, as amended.

6.4.7. There are a number of NIA near the Scheme. Close to the M5 there are two NIAs, NIA 3951 (Highways England) covers the existing junction and contains approximately 22 receptors. NIA 3952 (Highways England) is on the M5 approximately 800m north of the existing junction and contains 1 receptor.

6.4.8. On the A4019, to the West of the junction, is NIA 11921 (Gloucestershire). It represents one property between the M5 and Coombe Hill Junction.

6.4.9. On the A4019, East of the junction, there are 5 NIAs. NIA 3950 (Gloucestershire) represents 2 properties, NIA 3949 (Gloucestershire) represents 22 properties, NIA 3948 (Gloucestershire) represents 2 properties, NIA 11920 (Gloucestershire) represents 3 properties and NIA 3893 (Gloucestershire) represents 6 properties.

6.4.10. There are additional NIAs close to the study area which may also be affected by the Scheme, including those on the M5 north of Junction 11, the A4019, Princess Elizabeth Way, the A40 and a number of other roads within Cheltenham.

6.5. Assumptions and Limitations

6.5.1. The findings of the assessment will be based on the following assumptions:

- The location of all NSR within the study area can be identified in OS Addressbase Plus, but further informed by consultation with the local planning authority;
- The pavement team will provide details of the existing and proposed road surfacing for the Scheme.
- Information will be available regarding any existing noise barriers in the study area. If no information is available, suitable assumptions will be made based on Google Streetview images and site visits.
- The construction noise and vibration assessment will be limited by the availability and quality of information provided by the construction contractor. This could be mitigated through dialogue with the project civil engineering design team. In the absence of sufficient detailed information for the BS 5228 assessment, suitable assumptions will be made based on experience from similar projects in order to complete the assessment. All assumptions will be clearly stated in the ES.
- The results from the detailed noise modelling will be affected by limitations of the input data sources. The results from the detailed noise modelling will be influenced by information and assumptions used to derive traffic flow, speed, and fleet composition data from the strategic traffic model for the Scheme.
- The assessment of cumulative noise impacts will be based on the most relevant developments affecting the future year traffic flows, determined by the planners and traffic modellers.
- Similarly, the resolution of the ground topography data imported into the road traffic noise model will influence the results as it affects sound propagation. For example, datasets with a 10 m resolution will not take into account small variations in ground level that might be accounted for in datasets with smaller interval spacing.

6.6. Potential Impacts

6.6.1. The Scheme has the potential to affect the local noise climate, both during construction, and once in operation, in a number of ways, as discussed below.

Construction

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

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

Operation

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

6.7. Potential Effects and Mitigation Measures

Construction

6.7.1. During the construction phase, significant effects at the NSR are most likely to occur close to the construction activities, and particularly if night time works are required. The potential effects will be reduced as the separation distance increases between the NSR receptors and the construction works. The incorporation of temporary mitigation and the use of best practicable means can reduce noise impacts on receptors.

6.7.2. Best practicable means as defined by the Control of Pollution Act 1974 should be adopted in a CEMP to specifically include, but not limited to, measures such as:

- Limiting noisy construction activities to daytime hours only;
- Use of temporary noise screens/barriers/plant enclosures;
- Adoption of low noise or vibration techniques at all times;
- Locating plant away from noise and vibration sensitive receptors where feasible (including haul routes);
- Use of well-maintained vehicles and mobile plant, such that loose body fittings or exhausts do not rattle or vibrate; and
- Turning off plant and equipment when not in use.

Operation

6.7.3. During operation, the main factors that can cause a change in noise levels at nearby noise-sensitive receptors are:

- Changes to the traffic flow, speed or composition. Any alleviation to congestion caused by the Scheme is likely to increase the average traffic speeds on the M5 and connecting roads, therefore having the potential to lead to an increase in noise levels;
- Changes to the road alignment and layout. This includes changes to the horizontal or vertical alignment of existing carriageways and adding new sections of road. Realignment or rerouting traffic can cause decreases in areas where it was rerouted from and noise increases in areas it will be rerouted to; and
- Changes to the road surfacing.

6.7.4. It is not possible to determine whether these factors will cause a significant effect at this stage, but if significant adverse effects are predicted, noise mitigation will be proposed where effective and feasible.

6.7.5. Potential noise mitigation to improve existing noise levels or to reduce adverse impacts associated with the Scheme, could include noise barriers, earth bunds, low noise road surfacing and receptor-based mitigation, such as improved sound insulation and mechanical ventilation.

6.8. Likely Residual Effects

Construction

6.8.1. At properties that are within 100 m of the construction works, there is the potential for significant noise effects, even with mitigation in place. However the construction noise is temporary and residual effects are unlikely.

6.8.2. A significant adverse effect is determined for construction noise, or construction traffic noise, where a major or moderate magnitude of impact will occur for either: 10 or more days or nights in any 15 consecutive days or nights, or for a total number of days exceeding 40 in any 6 consecutive months.

Operation

6.8.3. The operational assessment of the Scheme will determine where there are potentially significant adverse noise effects, and where noise mitigation should be considered.

6.8.4. If a significant adverse effect is predicted at NSR, and there are situations where mitigation is not possible or fully effective, a list of properties will be provided as part of the assessment.

6.8.5. Although a full noise insulation assessment would not be carried out in the ES, a list of properties which have the potential to qualify based on the current scheme design will be included.

6.9. Proposed Level and Scope of Assessment

6.9.1. In accordance with DMRB LA 111, this scoping assessment will report on a series of issues and contextual factors in order to gain an understanding of the need to undertake further assessment.

6.9.2. This scoping assessment is based on available information.

Construction

6.9.3. For the construction noise and vibration, the factors for assessment are as follows:

- Whether construction noise or vibration generated by the project has the potential to adversely affect any noise or vibration sensitive receptors;
- Whether there are any noise receptors where there would be a reasonable stakeholder expectation that a construction noise assessment would be undertaken;
- Whether the scale of the development, or type of construction, mean that there will be a reasonable stakeholder expectation that a construction vibration assessment would be undertaken at any vibration sensitive receptors.

6.9.4. Where the response to one or more of the factors above is 'yes', the scoping assessment will make a recommendation on the scope of further assessment.

6.9.5. Given the distance between the Scheme and the NSR, there exists a potential for adverse noise and vibration during the construction period. Therefore, there is a reasonable stakeholder expectation for a construction noise and vibration assessment to be undertaken. Therefore an assessment of construction noise and vibration is scoped in, and will be undertaken broadly in line with the appraisal methodology, as defined within the DMRB LA 111.

Operation

6.9.6. For the operational noise, the factors for assessment are as follows:

- Whether the project likely to cause a change in the BNL of 1 dB LA10,18h in the do-minimum opening year (DMOY) compared to the do-something opening year (DSOY);
- Whether the project likely to cause a change in the BNL of 3 dB LA10,18h in the do-something future year (DSFY) compared to the DMOY;
- Whether the project involves the construction of new road links within 600m of the NSR;
- Whether there is a reasonable stakeholder expectation that an assessment would be undertaken.

6.9.7. Where the response to one or more of the factors above is 'yes', the scoping assessment willl make a recommendation on the scope of further assessment.

6.9.8. Given the distance between the Scheme and the NSR, there exists a potential for adverse noise during the operational period, and therefore a reasonable stakeholder expectation

for an operational noise assessment to be completed. Therefore an assessment of operational noise is scoped in, and will be undertaken broadly in line with the appraisal methodology, as defined within the DMRB LA 111.

6.9.9. However, as per DMRB LA 111, operational vibration is scoped out of this assessment. A maintained road surface will be free of irregularities as part of the project design, and under general maintenance, so operational vibration will not have the potential to lead to significant effects.

6.10. Proposed Assessment Methodology

Construction

6.10.1. The calculation of construction noise levels will follow the methodology in BS 5228-1. The predicted noise levels from construction noise sources will be compared against the assessment criteria shown in the DMRB LA 111. These assessment criteria are influenced by the existing baseline noise levels. Baseline noise levels will be ascertained using a combination of:

- Strategic noise mapping (DEFRA);
- Predicted 'do minimum opening year' noise levels;
- Baseline noise survey data.

6.10.2. Noise sources that are considered during the assessment include:

- Construction plant in use on the project;
- Construction compounds; and
- Traffic on haul roads that are not part of the public highway.

6.10.3. Details of the construction plant, including the activities being carried out, the number and types of plant being used and the typical working hours will be required to undertake this assessment.

Determination of significance - Noise

6.10.4. The predicted construction noise levels in dB L_{Aeq} will be compared with the relevant LOAEL an SOAEL from Table 6-1 for the identification of impacts.

Table 6-1 - Construction noise LOAEL and SOAEL values

Time Period	LOAEL	SOAEL
Day (0700-1900 weekday & 0700-1300 Saturdays)	Baseline noise levels $L_{Aeq,T}$	Threshold level determined as per BS 5228-1 Section E3.2 and Table E.1 BS 5228-1
Night (2300-0700)	Baseline noise levels $L_{Aeq,T}$	Threshold level determined as per BS 5228-1 Section E3.2 and Table E.1 BS 5228-1
Evening and weekends (time periods not covered above)	Baseline noise levels $L_{Aeq,T}$	Threshold level determined as per BS 5228-1 Section E3.2 and Table E.1 BS 5228-1

Source: Table 3.12, DMRB LA 111

6.10.5. As per DMRB LA 111, LOAEL values are determined using baseline noise levels. Where appropriate, the baseline noise level is identified using either baseline noise survey data, predicted noise levels or from the strategic noise mapping published by DEFRA, or a combination of all of these sources. A perceptible level of construction noise would be equal to or greater than the LOAEL value ascribed to a receptor.

6.10.6. SOAEL values will be identified using the ABC methodology outlined in BS 5228-1 (Section E3.2). Using the ABC method (see below, Table 6-2), SOAEL values are generated using the baseline noise levels, characterised for daytime, evening, and night-time periods. A potential significant effect is indicated if the noise level in $L_{Aeq,T}$ arising from the works exceeds the threshold level for the category appropriate to the ambient noise level.

Table 6-2 - The ABC method, BS 5228-1

Assessment category and threshold value period	Threshold value, in decibels (dB) (LAeq,T)		
	Category AA)	Category BB)	Category CC)
Night-time (2300 – 0700)	45	50	55
Evenings and weekends D)	55	60	65
Daytime (0700-1900) and Saturdays (0700 - 1300)	65	70	75

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

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

6.10.9. Note 3 Applied to residential receptors only.

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

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

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

D) 1900-2300 weekdays, 1300-2300 Saturdays and 0700-2300 Sundays

6.10.10. Once LOAEL and SOAEL values have been identified, the magnitude of potential noise impact is then assessed. To assess the magnitude of impact for construction noise at a given receptor, reference is made to DMRB LA 111, Table 3.16. 'Minor' magnitudes of impact are considered to represent the threshold of perceptibility (see Table 6-3below).

6.10.11. Construction traffic BNL changes shall be calculated for roads within the construction traffic study area using the methodology found in the 'Calculation of Road Traffic Noise', 1988 (CRTN).

6.10.12. Reference is made to DMRB LA 111 (Table 3.17) to identify the magnitude of impact on receptors. This is also included in Table 6-3below.

Table 6-3 - Magnitude of impact and construction noise descriptions

Magnitude of Impact	Construction Noise Level (L_{Aeq})	Change in Construction Traffic Noise Level ($L_{A10,18h}$)
Major	Above or equal to SOAEL +5 dB	Greater than or equal to 5 dB
Moderate	Above or equal to SOAEL and below SOAEL +5 dB	Greater than or equal to 3 dB and less than 5 dB
Minor	Above or equal to LOAEL and below SOAEL	Greater than or equal to 1 dB and less than 3 dB
Negligible	Below LOAEL	Less than 1 dB

Source: Tables 3.16 & 3.17, DMRB LA 111

6.10.13. A significant effect is determined for construction noise, or construction traffic noise, where a major or moderate magnitude of impact will occur for:

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

Determination of significance - Vibration

6.10.14. Predictions on the level of vibration will be made in accordance with the methodology found in BS 5228-2, 'Code of practice for noise and vibration control on construction and open sites. Vibration ' as prescribed by the DMRB LA 111. The significance of potential impacts will be ascertained using the methodology contained in DMRB LA 111, which takes into account the magnitude of the vibration and whether threshold levels for the LOAEL or SOAEL are exceeded.Table 6-4 below shows the vibration LOAEL and SOAEL values determined by DMRB LA 111.

Table 6-4 - Construction vibration LOAELs and SOAELs for all receptors

Time Period	LOAEL	SOAEL
All time periods	0.3 mm/s PPV	1.0 mm/s PPV

Source: Table 3.31, DMRB LA 111

6.10.15. To assess the magnitude of impact of construction vibration reference is made to DMRB LA 111, Table 3.33 . This is reproduced below in Table 6-5.

Table 6-5 - Magnitude of impact of vibration levels

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

Source: Table 3.33, DMRB LA 111

6.10.16. A significant effect attributed to construction vibration is likely where it is determined that a moderate magnitude of impact shall occur for:

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

6.10.17. Any major vibration impacts will be considered a significant effect irrespective of duration of activities and should be avoided.

Operation

6.10.18. The noise assessment will be carried out in line with DMRB LA 111, with predictions carried out using 3D noise models of the Scheme. The road traffic noise calculations will be undertaken in accordance with the modified CRTN methodology set out in DMRB LA 111 Appendix A2.

6.10.19. The predictions will be undertaken at all NSR within the study area, in order to identify the risks and constraints that noise imposes on the Scheme, as well as highlighting noise-sensitive areas that could be impacted by each of the potential Scheme. Both daytime noise levels ($L_{A10,18h}$) and night time levels (L_{night}) will be calculated using the noise model.

6.10.20. The results of the noise modelling will be used to determine potential noise impacts, and the requirement of noise mitigation.

6.10.21. In order to undertake the noise impact assessment for this study, the following traffic model output data is required as a minimum:

- Traffic flows in vehicles Annual Average Weekday Traffic (AAWT) 18hour;
- Traffic composition (the proportion of HDVs (heavy duty vehicles); and
- Traffic speeds.

6.10.22. DMRB LA 111 requires that the following traffic scenarios are assessed for the Scheme for a quantitative assessment:

- Do Minimum scenario in the opening year (DMOY);
- Do Minimum scenario in the future assessment year (DMFY) (typically 15 years after opening);
- Do Something scenario in the opening year (DSOY); and
- Do Something in the future assessment year (DSFY).

6.10.23. It is understood that there will additional versions of the future year traffic model, which will include the traffic from the proposed residential areas. These additional DMFY and DSFY scenarios will be assessed alongside those shown above.

6.10.24. These data should be supplied at an accurate geographical basis for a base year (year in which the appraisal in being undertaken), opening year and future assesment year (15 years after opening). The extent of the data needs to be sufficient to determine an ARN for each option.

6.10.25. For dual carriageways and motorways, traffic data will be provided separately for each carriageway, for example a northbound flow and southbound flow separately.

6.10.26. The following datasets will also be required to produce a technically robust assessment at this stage:

- 5m resolution digital terrain model data as Release 12 compatible .dxf or .shp contours, or lidar, covering the study area;
- OS Mastermap data including building outlines and carriageways covering the study area saved as Release 12 compatible dxf, or .shp;
- OS Addressbase Plus data covering the study area;
- Detailed road surfacing and existing noise barriers information covering the study area (e.g. HAPMS data, visual inspection data etc);
- Provision of the 3D alignment of the Scheme as polylines saved as Release 12 compatible .dxf, .dwg or .shp; and
- Details of existing and proposed noise mitigation.

Determination of Significance

6.10.27. Using DMRB LA 111, the following comparisons are required in order to determine the impact of the Scheme in both the short and long term.

- DMOY against DSOY (short term);
- DMOY against DSFY (long term); and
- DMOY against DMFY (long term).

6.10.28. DMRB provides classifications for the magnitude of changes in predicted road traffic noise as outlined below:

- A change in road traffic noise of 1dB(A) (DM to DS in the baseline year) is the smallest that is considered perceptible in the short term; and
- A change in road traffic noise of 3dB(A) (DM in the baseline year to DS in the future assessment year) is considered to be perceptible in the long term.

6.10.29. The magnitudes of impact in the short and long term are therefore considered differently within the DMRB methodology. For road traffic noise, the classification of magnitude of impact is reproduced from DMRB in Table 6-6 below for both the short and long terms.

Table 6-6 - Classification of Magnitude for Noise Impacts

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

Source: Modified from DMRB LA 111

6.10.30. In addition to this, the predicted noise levels at the NSR will be used to provide an indication of the number of properties that may potentially exceed the SOAEL and the LOAEL.

6.10.31. The thresholds assigned to the LOAEL and the SOAEL will be set based upon the example thresholds for significance set out in DMRB LA 111 guidance, as provided in Table 6-7.

Table 6-7 - Operational Noise Levels of Significance for all Receptors (Daytime and Night Time)

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

Source: DMRB LA 111

6.10.32. The DMRB LA 111 states that moderate and major adverse impacts are to be considered as potential significant adverse effects as part of an initial assessment. Final operational significance is determined with reference to contextual factors. This process requires the assessor to consider a number of holistic points related to the receptor and the wider environment before determining whether a significant adverse effect has arisen (see Table 6-8below).

Table 6-8 - Additional criteria for determining operational significance of effect

Magnitude of Impact	Long-term noise change (dB $L_{A10,18h}$ or L_{night})
Noise level change (is the magnitude of change close to the minor/moderate boundary?)	1) Noise level changes within 1 dB of the top of the 'minor' range can indicate that it is more appropriate to determine a likely significant effect. Noise level changes within 1 dB of the bottom of a 'moderate' range can indicate that it is more appropriate to consider a change is not a likely significant effect. 2) A similar change in the long term and non-project noise change can indicate that the change is not due to the project and not an indication of a likely significant effect.
Differing magnitude of impact in the long term to magnitude of impact in the short term	1) Where the long term impact is predicted to be greater than the short term impact, it can be appropriate to conclude that a minor change in the short term is a likely significant effect. Where the long term impact is predicted to be less than the short term it can be appropriate to conclude that a moderate or major change in the short term is not significant.
Location of noise sensitive parts of a receptor	1) If the sensitive parts of a receptor are protected from the noise source, it can be appropriate to conclude a moderate or major magnitude change in the short term and/or long term is not a likely significant effect.

Magnitude of Impact	Long-term noise change (dB $L_{A10,18h}$ or L_{night})
	2) Conversely, if the sensitive parts of the receptor are exposed to the noise source, it can be more appropriate to conclude a minor change in the short term and/or long term is a likely significant effect. 3) It is only necessary to look in detail at individual receptors in terms of this circumstance where the decision on whether the noise change gives rise to a significant environmental effect is marginal.
Acoustic context	If a project changes the acoustic character of an area, it can be appropriate to conclude a minor magnitude of change in the short term and/or long term is a likely significant effect.

Source: Table 3.60, DMRB LA 111

6.10.33. The DMRB LA 111 advises that the threshold of perceptibility for change in operational road noise is 1dB $L_{A10,18h}$ in the short-term and 3dB $L_{A10,18h}$ in the long-term (typically 15 years from the planned opening of a Scheme).

6.11. Proposed Consultation

6.11.1. Consultation with the environmental health officer or noise specialist of the local authority would be desirable to discuss the methodology, gain an understanding of local concerns and determine essential noise monitoring locations.

6.12. Conclusion

6.12.1. This chapter identifies a need for EIA for noise and vibration and sets out the methodology for the PCF Stage 3 assessment of the Scheme, including details of the baseline noise conditions.

7. Biodiversity

7.1. Introduction

7.1.1. This chapter provides the environmental scoping assessment of the Scheme for biodiversity. The chapter describes the baseline terrestrial and aquatic ecological features, as they are understood at present, and identifies the potential significant ecological effects that could arise from the Scheme. It also identifies any mitigation measures likely to be required, following the 'mitigation hierarchy'[27], to minimise harm to biodiversity.

7.1.2. The assessment at this stage is based on the findings from desk study, terrestrial and aquatic ecological walkover surveys and a suite of ecology surveys undertaken at PCF Stage 2. Further surveys are underway, or are proposed as part of PCF Stage 3, to ensure a robust baseline is established, and enable refinement of the assessment. Although a number of these surveys have been completed, the survey data have not yet been fully analysed, and the need for any further surveys will be reviewed following the analysis of the data. The scope of any further surveys considered necessary at present is described as fully as possible in this chapter.

7.1.3. The purpose of this chapter is to provide early identification of any likely significant effects in relation to biodiversity, identify any mitigation measures likely to be required, and provide an opportunity to agree where matters can be scoped out from further assessment.

7.2. Study Area

7.2.1. The study area extends beyond the Scheme footprint in accordance with the DMRB[28] and to accommodate minor changes in the extent of the footprint.

7.2.2. The extent to which the study areas extend beyond the Scheme was determined by the likely spatial scale of potential significant effects for each type of ecological feature, i.e. the Zones of Influence. These are based on good practice guidance, where available (references provided), but in most cases are determined by professional judgement.

- 30 km from the Scheme for identification of European Sites[29] where bats are one of the qualifying features[30];
- 2 km from the Scheme (extended to any distance where there is a direct hydrological connection) for identification of all other statutory designated nature conservation sites, including European Sites, Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs) and Local Nature Reserves (LNRs);
- 2 km from the Scheme for identification of any bat species records;
- 1 km from the Scheme for identification of non-statutory designated nature conservation sites (e.g. Local Wildlife Sites) and records of priority habitats[31] and ancient woodland;
- 1 km from the Scheme for identification of any protected or notable[32] species

[27] The 'mitigation hierarchy' seeks as a preference to avoid impacts then to mitigate unavoidable impacts, and, as a last resort, to compensate for unavoidable residual impacts that remain after avoidance and mitigation measures (The British Standards Institution (2013). *BS 42020:2013. Biodiversity — Code of practice for planning and development*.)
[28] Design Manual for Roads and Bridges. 2019. LA 104 Environmental assessment and monitoring. Online https://www.standardsforhighways.co.uk/dmrb/search/78a69059-3177-43dc-94bd-465992cfda82. [Accessed July 2020]
[29] Also referred to as Natura 2000 sites, these should be taken as including: Sites of Community Importance (SCIs), Special Protection Areas (SPAs), potential SPAs (pSPAs), Special Areas of Conservation (SACs), candidate SACs (cSACs), possible SACs (pSACs) and Ramsar sites.
[30] Design Manual for Roads and Bridges. LA 115 Habitats Regulations Assessment (formerly HD 44/09). Online: http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section4/LA%20115%20Habitats%20Regulations%20assessment%20-web.pdf [Accessed 21/10/19].
[31] Priority habitats are those habitats listed in accordance with Section 41 of the Natural Environment and Rural Communities Act 2006 (the NERC Act) as being of principal importance for the conservation of biodiversity in England.
[32] Notable species in this context comprise species listed in accordance with Section 41 of the NERC Act; IUCN Red List species; Red and Amber Birds of Conservation Concern; and species that are Nationally Scarce or Rare.

records;

- 500 m from the Scheme for identification and survey of waterbodies that could potentially support breeding populations of great crested newt[33] and watercourses and waterbodies that could potentially support otter and water vole;
- 250 m from the Scheme for habitat surveys and assessment of potential to support protected or notable species;
- 250 m from the Scheme for identification of ancient and veteran trees;
- 150 m from the Scheme for identification of aquatic features (watercourses and standing waterbodies). Where a watercourse has been identified within 150 m of the Scheme, the walkover study area is extended up to 250 m upstream and downstream and up to 2 km upstream and downstream for any species records for the specific watercourse;
- 100 m from the Scheme for assessment of building and tree bat roost potential. This is extended where buildings and trees beyond 100 m would be isolated by the Scheme. This was reduced to 50 m along the A4019, given the more urbanised nature of this area, and the more limited impacts.

7.3. Planning policy and topic legislative context

National policy

National Policy Statement for National Networks (NN NPS, 2014)

7.3.1. The Scheme falls within the definition of an NSIP, making the NN NPS the primary planning policy against which an application for a DCO for the Scheme would be judged.

7.3.2. Paragraphs 5.20 – 5.38 of NN NPS, 2014 specifically relate to ecology and biodiversity conservation. Of particular relevance to the Scheme are paragraphs 5.22 and 5.23, which outline the requirement to *'ensure that the environmental statement clearly sets out any likely significant effects on internationally, nationally and locally designated sites of ecological or geological conservation importance'*. Furthermore, the applicant should show the extent to which the project has '*taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests'*.

7.3.3. Paragraph 5.26 outlines that appropriate weight should be attached to designated sites of international, national and local importance, protected species, habitats and other species of principal importance for the conservation of biodiversity, and to biodiversity and geological interests within the wider environment.

7.3.4. Paragraph 5.27 discusses international sites, stating that these are the most important sites for biodiversity, and are provided statutory protection under the Habitats Regulations.

7.3.5. Paragraph 5.28 discusses Sites of Special Scientific Interest (SSSIs) as requiring a high degree of protection. Paragraph 5.29 goes on to state that '*where a proposed development is likely to have an adverse effect on a SSSI, development consent should not normally be granted. Where an adverse effect on the site's notified special interest features is likely, an exception should be made only where the benefits of the development at this site clearly outweigh both the impacts that it is likely to have on the features of the site that make it of special scientific interest, and any broader impacts on the national network of SSSIs'*

7.3.6. Paragraph 5.31 outlines that whilst due consideration should be given to regional or local biodiversity designations, they would not constitute a reason to refuse development consent.

7.3.7. Paragraph 5.32 discusses irreplaceable habitats including ancient woodland and veteran trees, stating 'The Secretary of State should not grant development consent for any development that would result in the loss or deterioration of irreplaceable habitats including ancient woodland and the loss of aged or veteran trees found outside ancient

[33] This species typically uses suitable terrestrial habitat up to 500 m from a breeding pond (Natural England (2001). Great Crested Newt Mitigation Guidelines. English Nature, Peterborough.

woodland, unless the national need for the benefits of the development, in that location, clearly outweigh the loss.'

7.3.8. Paragraph 4.23 sets out that any application should be accompanied by sufficient information to enable examining authority to undertake an appropriate assessment under the Habitats Regulations.

National Planning Policy Framework (NPPF, 2019)

7.3.9. Given that the Scheme is an NSIP, the NPPF has the status of a material consideration in planning terms.

7.3.10. Paragraph 170 states that 'planning policies and decisions should contribute to and enhance the natural and local environment by:'

- Protecting sites of biodiversity; and
- Minimising impacts on and providing net gains for biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures.

7.3.11. Paragraph 174 builds on this by stating that plans should protect and enhance biodiversity through the identification and safeguarding of *'components of local wildlife-rich habitats and wider ecological networks, including the hierarchy of international, national and locally designated sites of importance for biodiversity'. Furthermore, plans should 'promote the conservation, restoration and enhancement of priority habitats, ecological networks and the protection and recovery of priority species; and identify and pursue opportunities for securing measurable net gains for biodiversity.'*

7.3.12. Paragraph 175 states that, 'if significant harm to biodiversity resulting from a development cannot be avoided (through locating on an alternative site with less harmful impacts), adequately mitigated, or, as a last resort, compensated for, then planning permission should be refused.'

7.3.13. Building on the previous version of the NPPF, planning practice guidance (published January 2016) explains the key issues in implementing policy to protect biodiversity, including local requirements.

The UK Biodiversity Action Plan (BAP) and Post-2010 Biodiversity Framework 2012

7.3.14. The BAP is the UK's initiative to maintain and enhance biodiversity in response to the Convention on Biological Diversity signed in 1992. The UK BAP was used to draw up the 'England Biodiversity List' and has been succeeded by the UK Post-2010 Biodiversity Framework in 2012, due to a change in government strategy by all UK countries, focussing on managing the environment as a whole rather than dealing with different aspects of biodiversity and environment separately. However, the UK BAP list of priority habitats and species continue to be regarded as conservation priorities in the UK Post-2010 Biodiversity Framework (JNCC & DEFRA 2012).

Regional policy

Gloucestershire Local Transport Plan 2020–2041

7.3.15. LTP PD 4.2 – Highway network resilience states that 'GCC will provide a resilient highway network that can withstand unforeseen events including extreme weather events and long term changes to the climate' by regularly reviewing the winter maintenance and vegetation clearance procedures and policies and in line with the Gloucestershire Highways Biodiversity Guidance (January 2015) or subsequent guidance. The reference to the Gloucestershire Highways Biodiversity Guidance is reaffirmed in LTP PD 4.3 – Highway Maintenance.

7.3.16. LTP PD 4.9 – Environment states that GCC will work with District Councils to improve biodiversity loss resulting from traffic on the highway network, by complying with Gloucestershire Highways Biodiversity Guidance (January 2015) or subsequent guidance.

Local policy

Joint Core Strategy (JCS) 2011-2031

7.3.17. Strategic Objective 4 – Conserving and enhancing the environment states that planning policy and decisions should 'Conserve, manage and enhance the area's unique natural environment and great biodiversity, including its waterways, Sites of Special Scientific Interest (SSSI), the Cotswold's AONB, and areas of landscape and biodiversity importance.'

7.3.18. Policy SD9: Biodiversity and Geodiversity outlines the stance that the biodiversity resource of the JCS area will be protected and enhanced through conserving and enhancing biodiversity and geodiversity on internationally, nationally and locally designated sites, as well as encouraging new development to contribute positively to biodiversity and geodiversity whilst linking with wider networks of green infrastructure.

7.3.19. SD9 also states that 'harm to the biodiversity or geodiversity of an undesignated site or asset should be avoided where possible.' Where risk of harm cannot be avoided, appropriate mitigation should be provided through 'integrating enhancements into the Scheme that are appropriate to the location.'

Cheltenham Borough Local Plan – Saved Policies (2006)

7.3.20. Policy CP 3: Sustainable Environment states that development will be permitted only where it would 'safeguard and promote biodiversity'.

Gloucestershire Local Nature Partnership (GLNP)

7.3.21. Pre-2012, the BAP for Gloucestershire contained a series of Habitat Action Plans and Species Action Plans. These took into account national priorities using the knowledge of local experts to devise what action was needed at a local level to conserve and enhance biodiversity. From 2007 there was a review of the Gloucestershire BAP, which moved Gloucestershire towards a more spatially-based biodiversity delivery framework and resulted in the compilation of the Gloucestershire Nature Map in 2008 which was updated in late 2011. By 2012, Local Nature Partnerships were announced and this biodiversity framework was subsumed into what is now the GLNP. GLNP adopted Nature Map with a focus on priority habitats and species, which have now been incorporated into DEFRA's Nature Improvement Areas and create joined up and resilient ecological networks at a landscape scale.

7.3.22. With the launch of the Government's 25 Year Environment Plan, GLNP are in the process of developing a Nature Recovery Network.

Legislative context

The Conservation of Habitats and Species Regulations 2017

7.3.23. The regulations cover the designation and protection of European sites and the protection of European protected species.

Wildlife and Countryside Act 1981 (as amended)

7.3.24. The primary legislation which protects animals, plants and habitats in the UK.

Natural Environment and Rural Communities (NERC) Act 2006

7.3.25. Section 40 of the NERC Act 2006 sets out the duty for public authorities to conserve biodiversity in England. Habitats and species of principal importance for the conservation of biodiversity are identified by the Secretary of State for England, in consultation with Natural England, are referred to in Section 41 of the NERC Act for England. The 'England Biodiversity List' is used as a guide for decision makers such as public bodies, including local and regional authorities, in implementing their duty under Section 40 of the NERC Act 2006 to have regard to the conservation of biodiversity in England when carrying out their normal functions.

The Protection of Badgers Act 1992

7.3.26. It is an offence to wilfully kill, injure or take a badger; or intentionally or recklessly damage, destroy or obstruct access to a badger sett or disturb a badger in its sett. It is not illegal to carry out disturbance activities in the vicinity of setts that are not occupied.

7.3.27. Where required, licences for development activities involving disturbance or sett interference or closure are issued by Natural England. Licences are normally not granted from December to June inclusive because cubs may be present within setts.

The Hedgerow Regulations 1997

7.3.28. Under the regulations, it is against the law to remove or destroy certain hedgerows without permission from the local planning authority. In general, permission will be required before removing hedges that are at least 20 m in length, over 30 years old and contain certain species of plant. The local planning authority will assess the importance of the hedgerow using criteria set out in the regulations.

7.4. Baseline Conditions

Baseline data collection

Desk study

7.4.1. A desk-based data gathering exercise was undertaken in September 2019 to collect existing information on ecological features within the study areas described above. Details of the various searches and data sources are provided below.

7.4.2. In 2018, Ecus undertook a Preliminary Ecological Appraisal (PEA) for the M5 Junction 10 Improvement Scheme[34]. Although the PEA did not cover large parts of the current study area and was undertaken at a sub-optimal time of year for habitat classification (late October), it was reviewed to obtain any relevant information.

7.4.3. The Magic website[35] was reviewed to identify:

- European Sites within 30 km of the Scheme where bats are one of the qualifying features;
- Statutory designated nature conservation sites within 2 km of the Scheme or with a direct hydrological connection;
- Priority habitats and ancient woodland within 1 km of the Scheme; and
- Granted European Protected Species (EPS) licences[36] within 1 km of the Scheme (2 km for bats).

7.4.4. The Woodland Trust's Ancient Tree Inventory website[37] was reviewed to locate records of ancient and veteran trees within 250 m of the Scheme.

7.4.5. Gloucestershire Centre for Environmental Records (GCER) was contacted on 11th September 2019 to obtain recent records[38] of:

- Non-statutory designated nature conservation sites within 1 km of the Scheme;
- Bat species within 2 km of the Scheme; and
- Other protected and notable species within 1 km of the Scheme.

7.4.6. Ordnance Survey (OS) maps and satellite imagery (also on the Magic website) were used to identify:

[34] Ecus (2019). M5 J10 Preliminary Ecological Appraisal. Report prepared for Amey OW PLC, December 2018.
[35] DEFRA. c2019. Magic Map Application. [Online]. [Accessed 5th September 2019]. Available from: https://magic.defra.gov.uk/MagicMap.aspx
[36] Licences granted by Natural England to permit activities that might otherwise cause a breach of the Conservation of Habitats and Species Regulations 2018, with respect to species protected by that legislation.
[37] Woodland Trust. 2019. Ancient Tree Inventory - Woodland Trust. [Online]. [Accessed 5th September 2019]. Available from: https://ati.woodlandtrust.org.uk/
[38] Records of observations within the last 10 years.

- Waterbodies that could be suitable for great crested newt within 500 m of the Scheme; and
- Buildings that could support bat roosts within 100 m of the Scheme or that would be isolated by the Scheme (i.e. where existing connections to surrounding habitat would be severed by new roads).

7.4.7. OS mapping, the Environment Agency Statutory Main Rivers Map[39] and aerial imagery were reviewed to identify watercourses and standing waterbodies within 150 m of each of the Scheme options for the assessment of aquatic habitats and species (macroinvertebrates, macrophytes and fish). Recent[40] background species/ habitat records from these watercourses were reviewed within 2 km upstream and downstream of the Scheme, to provide representative baseline data The following data sources have been used:

- Environment Agency biological monitoring site data for aquatic invertebrates, aquatic macrophytes and fish from the Government data website[41];
- Environment Agency River Habitat Survey monitoring data from the Government data website[42]; and
- Environment Agency Water Framework Directive (WFD)[43] Classification Data and River Basin Management Plans (RBMPs) from the Catchment Data Explorer website[44].

Field surveys

7.4.8. The following paragraphs outline the ecological survey work that has been undertaken to-date. Surveys were led by suitably experienced ecologists (considered competent to undertake specific surveys in accordance with the Chartered Institute of Ecology and Environmental Management (CIEEM)[45]), who are members of CIEEM.

7.4.9. A walkover survey of accessible land within 250 m of the Scheme was undertaken in May and September 2019 to validate habitat mapping undertaken previously and to identify habitats and features that could potentially support protected and notable species within the study area. Habitat classification was undertaken in accordance with the Joint Nature Conservation Committee (JNCC) Phase 1 Habitat Survey methodology[46]. Habitats were recorded on base maps of the study area along with target notes to describe the characteristic plant species and any habitats/features suitable for protected and notable species or signs of their presence.

7.4.10. Bat surveys are being undertaken in accordance with Bat Conservation Trust (BCT) good practice survey guidelines[47]. Surveys undertaken to-date include:

- Preliminary Roost Assessment (PRA) of buildings within the study area.
- Emergence/re-entry survey of buildings assessed as having greater than negligible bat roost potential during the PRA.
- Ground Level Tree Assessment (GLTA) of trees within the study area.
- Tree climbing of trees within the study area that were assessed as having moderate or higher bat roosting potential as a replacement for emergence/re-entry surveys. Trees with moderate potential were climbed two times in the survey season (May – September) to search for evidence of roosting bats, and trees with

[39] https://www.arcgis.com/apps/webappviewer/index.html?id=17cd53dfc524433980cc333726a56386 [Accessed 11 July 2019]
[40] . 'Recent' in this instance is defined as any survey since 2014 (i.e. c. five years old or less).
[41] https://data.gov.uk/data/search [Accessed 11 July 2019]
[42] https://data.gov.uk/data/search [Accessed 11 July 2019]
[43] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.
[44] Environment Agency. Catchment Data Explorer. [online] Available at: <http://environment.data.gov.uk/catchment-planning/> [Accessed 18 July 2019].
[45] https://cieem.net/resource/competencies-for-species-survey-css/
[46] JNCC (2010). Handbook for Phase 1 Habitat Survey – A Technique for Environmental Audit [Online]. Available at: http://data.jncc.gov.uk/data/9578d07b-e018-4c66-9c1b-47110f14df2a/Handbook-Phase1-HabitatSurvey-Revised-2016.pdf
[47] Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London.

high potential were climbed three times in the survey season (May – September).

- Tree emergence/re-entry surveys of trees with moderate or higher bat roosting potential which could not be climbed safely, or where features could not be assessed during tree climbing. The tree emergence surveys were weighted preferentially towards the use of infra-red cameras over surveyors[48].
- All trees assessed to have hibernation potential were subject to a hibernation tree climb in February 2020.
- Bat activity surveys, including transect surveys and static detector surveys were undertaken to identify levels of activity, key foraging and commuting areas, and the bat species present. Ten transect routes were identified, with two static detectors located along each transect. Another 15 static detectors were deployed across the Scheme to provide additional information on the surrounding habitat.
- Bat crossing point surveys were undertaken at five locations where the Scheme would sever hedgerows, and therefore potentially impact the foraging and commuting habitats of bats. The crossing point surveys were conducted using the methodology produced by DEFRA[49].

7.4.11. Hazel dormouse surveys have been undertaken in accordance with good practice guidance[50]. An initial hazel dormouse habitat suitability assessment was undertaken during the terrestrial ecology walkover surveys of the study area aided by the use of the desk study information (Ordnance Survey mapping and aerial imagery) to view these habitats in the context of the wider landscape. Hazel dormouse nest tube surveys were carried out between May and November 2019, as access allowed over the survey period. 666 artificial nest tubes were placed in seven distinct areas in suitable habitat (woodland, hedgerows and scrub) in 35 transects throughout the study area and checked by a licensed surveyor every two months up to November 2019.

7.4.12. To date, no specific surveys for badger have been carried out, but incidental records have been made during other surveys, which has provided extensive coverage of the study area.

7.4.13. Otter presence / likely absence surveys were carried out between September and November 2019. The surveys were undertaken following good practice methodologies and were based on otter survey protocols set out in Chanin and Smith (2003)[51]. Identified potential otter resting sites (five locations) were monitored to assess activity levels. This comprised the deployment of trail cameras to monitor the features for two four-week periods in July 2020 and September/ October 2020.

7.4.14. Water vole habitat suitability assessment surveys were carried out in September and November 2019 according to good practice guidance[52,53]. Habitat features which were assessed as suitable during the habitat suitability assessments undertaken in September 2019 were then immediately subject to a presence/likely absence survey for water vole. A second water vole presence/ likely absence survey was undertaken for suitable habitat features in June 2020; this comprised sections of the River Chelt and one minor watercourse. The habitat features which were surveyed in November 2019 were scoped

[48] It is accepted that this goes against the BCT good practice survey guidelines, which states that 'while such equipment is very useful as a complementary technique, it should not be used to replace surveyors to any significant degree; the majority of any site should be observed by surveyors.' The more recent Thermal Imaging: Bat Survey Guidelines (Fawcett Williams (2019) Thermal Imaging: Bat Survey Guidelines - produced in association with the BCT) endorses the use of thermal imaging cameras as a replacement for one or more surveyors. It is considered that there is a trend towards using cameras in place of surveyors, and that this is at least as reliable, if not more so, than surveyors. It is anticipated that the guidance regarding the use of infra-red cameras will be brought into line with the thermal imaging guidance in the near future.
[49] Berthinussen, J & Altringham, J (2015) WC1060 Development of a cost-effective method for monitoring the effectiveness of mitigation for bats crossing linear transport infrastructure. Appendix G: Local effects of transport infrastructure & mitigation: best practice survey protocol and data analysis.
[50] Natural England Standing Advice: Hazel or common dormice: surveys and mitigation for development projects, accessed May2019 from: https://www.gov.uk/guidance/hazel-or-common-dormice-surveys-and-mitigation-for-development-projects
[51] Chanin and Smith (2003). *Monitoring the otter Lutra lutra*. Conserving Natura 2000 Rivers Monitoring Series No 10. Peterborough, English Nature.
[52] Strachan, R. and Moorhouse, T. (2011). Water Vole Conservation Handbook (3rd edition). Wildlife Conservation Research Unit, University of Oxford.
[53] Dean, M. et al The Water Vole Mitigation Handbook (2016). Mammal Society.

out from further assessment (due to unsuitable habitat) and therefore presence / likely absence surveys for water vole were not undertaken here in 2020.

7.4.15. Breeding bird surveys were undertaken on three occasions (June and July 2019 and May 2020 respectively) by a suitably experienced ecologist. The principles of the Common Birds Census mapping methodology developed by the British Trust for Ornithology (BTO) were broadly followed[54]. This level of survey effort was considered suitable to generate enough encounters with birds to produce clusters of registrations to minimise the risk of overlooking scarce species and/or species of conservation concern. Six representative transects of varying lengths were surveyed, which gave suitable coverage of the study area. The data captured over the survey visits was analysed to provide an estimate of the number of recorded priority species territories[55][56][57].

7.4.16. Surveys for barn owl have been incorporated into the bat building and tree surveys. This has included identification of features potentially suitable for nesting, roosting or foraging barn owls. Incidental records of barn owl were also collected during other surveys.

7.4.17. Wintering bird surveys were undertaken each month from September 2019 to March 2020 includsive. The wintering bird survey method used involves recording all birds on a map as with a Common Birds Census survey but during the non-breeding season. This method allows presence, abundance and spatial distribution to be recorded. A total of six wintering bird survey visits was considered suitable to generate enough encounters with birds to characterise usage of the study area by wintering (and migrating) birds and minimise the risk of overlooking scarce species and/or species of conservation concern. Six representative transects of varying lengths were surveyed, which gave suitable coverage of the study area.

7.4.18. Presence/ likely absence surveys for common species of reptile[58] were carried out between August and October 2019 and August and October 2020 in accordance with standard survey guidance[59, 60, 61]. Artificial refuges, consisting of roofing felt and corrugated metal sheets ('tins') measuring approximately 0.5 m^2, were laid out in 27 survey transects within suitable habitat. Seven checks of the artificial refuges were undertaken in suitable weather conditions.

7.4.19. Nineteen waterbodies were identified within 500 m of the Scheme. In June 2019 and June 2020, great crested newt habitat suitability surveys and environmental DNA (eDNA) surveys were undertaken of all accessible waterbodies (13 waterbodies). The habitat suitability survey followed the Habitat Suitability Index (HSI) methodology developed by

[54] Gilbert, G., Gibbons, D.W. and Evans, J. (1998) Bird monitoring methods: A manual of techniques for key UK species. RSPB: Sandy.
[55] For this assessment, notable birds have been taken as those listed on: Schedule 1 of the Wildlife and Countryside Act (1981); Annex 1 (under Article 4,1) and regularly occurring migratory bird species (under Article 4.2) of Directive 2009/147/EC (the Birds Directive) and interest features of relevant Ramsar sites (Severn Estuary SPA and Ramsar and Walmore Common SPA); Red or amber lists of Birds of Conservation Concern, the England Biodiversity List and the Gloucestershire Biodiversity Action Plan.
[56] The UK's leading bird conservation organisations have worked together on a quantitative review of the status of the birds that occur regularly in the UK (currently on the third review). Bird species have been assessed against a set of objective criteria to place each on one of three lists – green, amber and red – indicating an increasing level of conservation concern. The criteria used in assessments are intended to ensure that Birds of Conservation Concern (BoCC) listings reflect each species' global and European status as well as that within the UK, and additionally measure the importance of the UK population in international terms.
The findings of the third review are in: Eaton, M.A., Brown A.F., Noble D.G., Musgrove, A.J., Hearn R.D., Aebischer N.J., Gibbons D.W., Evans A., and Gregory R.D. (2009). Birds of Conservation Concern 3: The population status of birds in the United Kingdom, Channel Islands and the Isle of Man. British Birds 102: 296-341.
[57] Section 40 of the Natural Environment and Rural Communities (NERC) Act 2006 sets out the duty for public authorities to conserve biodiversity in England. Habitats and species of principal importance for the conservation of biodiversity as identified by the Secretary of State for England, in consultation with Natural England, are referred to in Section 41 of the NERC Act 2006 for England. The list of habitats and species was updated in 2008 and is known as the England Biodiversity List.
[58] Due to the restricted ranges of smooth snake and sand lizard, these species are not considered within this report.
[59] Froglife (1999) Reptile Survey: an introduction to planning, conducting and interpreting surveys for snake and lizard conservation. Froglife advice sheet 10.
[60] Design Manual for Roads and Bridges. 2019. Sustainability and Environment Design. LD 118 Biodiversity Design (formerly LA 118). Online: https://www.standardsforhighways.co.uk/dmrb/search/9317652b-4cb8-4aaf-be57-b96d324c8965
[61] Sewell D., Griffiths R., Beebee T., Foster J., & Wilkinson J. (2013). Survey protocols for the British herpetofauna. Version 1.0.

Oldham et al. (2000)[62]. eDNA survey followed the Natural England approved methodology described by Biggs et al. (2014)[63]. Water samples were collected from each pond and sent to ADAS or SureScreen Scientifics[64] for laboratory analysis.

7.4.20. Hedgerows potentially impacted by the Scheme were identified using the survey area for the Phase 1 Habitat Survey. Hedgerow surveys were undertaken between June and August 2019. The survey methodology followed the guidelines in the Hedgerow Survey Handbook[65]. Following the survey, the results were assessed against the wildlife and landscape criteria for determining 'important' hedgerows set out in Schedule 1, Part 2 of the Hedgerow Regulations 1997.

7.4.21. An aquatic ecology walkover survey was undertaken in July 2019 of watercourses potentially affected by the Scheme. These watercourses were visited at the point of interaction with the Scheme (i.e. a proposed crossing point) and, where feasible, 250 m up and downstream of these interactions. During the survey, habitat characteristics were recorded broadly following habitat descriptors outlined in River Habitat Survey (RHS) methodology[66]. The aquatic ecology walkover survey was designed to assess the suitability of the watercourses for fish and other aquatic species, as well as determine the requirement for further detailed surveys.

7.4.22. Watercourses within the study area were screened as requiring habitat surveys (RHS and River Corridor Survey (RCS)) based on the following criteria:

- The watercourse is a main river, or an ordinary watercourse for which a Water Framework Directive (WFD) status is reported and is potentially affected by the Scheme; or
- It is an ordinary watercourse (potentially affected by the Scheme) for which a WFD status is not reported and is not heavily modified or managed (as determined by the aquatic ecology walkover survey and desk study).

7.4.23. The River Chelt and the Leigh Brook were the only watercourses to meet the criteria listed above. RHS and RCS were undertaken on these watercourses following standard survey guidance[67] in July 2020. These surveys captured information on channel substrates, vegetation types, flow types, approximate channel dimensions, presence and extent of any re-sectioning and existing structures. RHS and RCS were located at Scheme interactions and undertaken on 500 m reaches.

7.4.24. Following the aquatic ecology walkover survey, watercourses were screened for detailed ecological survey requirements (namely aquatic invertebrate, aquatic macrophyte and fish survey) dependent on whether the watercourse exhibited suitable habitat for the detailed survey type and whether there were any suitable baseline data (namely Environment Agency monitoring data) to act as an alternative to survey. Two electric fishing surveys on the River Chelt were screened as required. These were undertaken in July 2020 and were located at or immediately adjacent to two Scheme crossing locations. The surveys were undertaken in accordance with current industry standards[68].

7.4.25. Four aquatic invertebrate surveys are scheduled for the River Chelt and one for the Leigh Brook in October 2020. These surveys shall follow a standard three-minute kick-sampling technique in accordance with River Invertebrate Prediction Classification System 2 (RIVPACS2). Following survey, species/ mixed level identification of aquatic invertebrates

[62] Oldham R.S., Keeble J., Swan M.J.S. & Jeffcote M. (2000). Evaluating the suitability of habitat for the Great Crested Newt (*Triturus cristatus*). Herpetological Journal 10 (4), 143-155.
[63] Biggs J., Ewald N., Valentini A., Gaboriaud C., Griffiths R.A., Foster J., Wilkinson J., Arnett A., Williams P. & Dunn F. (2014). Analytical and methodological development for improved surveillance of the Great Crested Newt. DEFRA Project WC1067. Freshwater Habitats Trust: Oxford.
[64] SureScreen Scientifics is a participant in Natural England's eDNA proficiency testing scheme and achieved 80% in blind tests undertaken in 2020. ADAS is a participant in Natural England's eDNA proficiency testing scheme and has achieved perfect scores in blind tests undertaken in 2017, 2018, 2019 and 2020.
[65] DEFRA (2007) Hedgerow Survey Handbook. A standard procedure for local surveys in the UK. DEFRA, London
[66] Environment Agency (2003) River Habitat Survey in Britain and Ireland - Field Survey Guidance Manual
[67] Environment Agency (2003) River Habitat Survey in Britain and Ireland - Field Survey Guidance Manual and National Rivers Authority (1992). River Corridor Surveys: Methods and Procedures.
[68] BS EN 14962:2006 / BS 6068-5.40:2006 Water quality – Guidance on the scope and selection of fish sampling methods; BS EN 14011:2003 / BS 6068-5.32:2003 Water quality – Sampling of fish with electricity; Environment Agency (2010) Electric fishing in rivers. Operational Instruction 144_03; and CEH (2002) Guidelines for Electric Fishing Best Practice R&D Technical Report W2-054/TR.

shall be undertaken in accordance with Environment Agency Operational Instruction 024_08[69]. For each sample, a suite of biological metrics shall be calculated and interpreted to provide an assessment of the health of the watercourses and associated invertebrate communities.

7.4.26. Aquatic macrophyte surveys were undertaken in July 2020 for the River Chelt and Leigh Brook in accordance with good practice guidance[70].

7.4.27. White clawed crayfish surveys were undertaken in July 2020 for the River Chelt and Leigh Brook, comprising visual assessment of available habitat features and a manual search of refuge habitats within five patches along the reaches surveyed for RHS and RCS following standard survey methodology[71].

Valuation of ecological features

7.4.28. Ecological features have been valued following the geographical framework provided in LA 108[72]. The evaluation is based on the information gathered from the desk study and field surveys, using a combination of professional judgement and accepted criteria[73] (e.g. diversity, rarity and naturalness).

7.4.29. Where survey information is incomplete, a precautionary approach has been taken and the highest likely value has been ascribed, based on interpretation of the information that is available. In these cases, it is clearly stated that the value is precautionary and preliminary. Details of any relevant assumptions are also clearly stated, along with details of any further survey work required/ underway to enable a more robust evaluation.

7.4.30. Features that have been identified to be of less than local importance are not considered to be important ecological features and, as such, it is proposed to scope these features out of the EIA. Where mitigation is required for these features for legal reasons, this is detailed in Section 7.7.

Baseline conditions and initial valuation

7.4.31. Table 7-1, below, provides a summary of the results of the baseline surveys undertaken to-date, and an initial assessment of the relative importance of the biodiversity resources in accordance with LA 108[74].

[69] Environment Agency Operational Instruction 024_08- Freshwater macro-invertebrate analysis of riverine samples (issued 02/10/2012).
[70] CEN – EN 14184 Water Quality Guidance Standards for the Surveying of Aquatic Macrophytes in Running Waters; and Environment Agency (2007) Surveying Freshwater Macrophytes in Rivers. Operational Instruction 131_07
[71] Peay S (2003). Monitoring the White-clawed Crayfish *Austropotamobius pallipes*. Conserving Natura 2000 Rivers Monitoring Series No. 1, English Nature, Peterborough.
[72] LA 108 Biodiversity (Highways England, March 2020). [Online]. [Accessed October 2020]. Available from: https://www.standardsforhighways.co.uk/dmrb/search?discipline=SUSTAINABILITY_AND_ENVIRONMENT.
[73] Set out in Ratcliffe, D.A (1977). A Nature Conservation Review. Cambridge University Press.
[74] LA 108 Biodiversity (Highways England, March 2020). [Online]. [Accessed October 2020]. Available from: https://www.standardsforhighways.co.uk/dmrb/search?discipline=SUSTAINABILITY_AND_ENVIRONMENT.

Table 7-1 - Summary of results of baseline surveys undertaken to-date and initial valuation of ecological features

Ecological Feature	Summary of Desk Study Information	Summary of Field Survey Results and Preliminary Valuation
Designated sites	**Wye Valley and Forest of Dean Bat Sites SAC** – this designated site represents a complex of 13 component SSSIs which support the greatest concentration of lesser horseshoe bat in the UK (26% of the national population) and represents the northern part of the range for greater horseshoe bat (6% of the UK population). The nearest of the SAC sites (Blaisdon Hall SSSI) is located approximately 21 km west of the Scheme (similar distance for all Scheme options). **Severn Estuary SAC/ SPA/ Ramsar/ SSSI** – All of the watercourses which are crossed by the Scheme eventually flow into the River Severn, at least 7.5 km downstream. From the nearest confluence point, where the River Chelt joins the River Severn, just upstream of Wainlode Cliff, the Severn Estuary is a further 33 km downstream. The Severn Estuary supports the following features of nature conservation importance: • Estuarine habitats, including estuaries; mudflats and sandflats not covered by seawater at low tide; Atlantic salt meadows; sandbanks which are slightly covered by seawater all the time; and reefs; • Populations of sea lamprey, river lamprey and twaite shad; • >4% of the British overwintering population of Bewick's swan; • Significant wintering populations of curlew, dunlin, pintail, redshank and shelduck; • Significant passage population of ringed plover; and • Regular assemblages of over 20,000 wildfowl, which qualify the site as a wetland of international importance. **Walmore Common SPA** – this site comprises 53 ha of damp grassland and ditches, which flood regularly during the winter and support Bewick's swan as a qualifying feature. The site is located approximately 17.5 km south west of the Scheme. **Coombe Hill SSSI** – this site consists of a 3.7 km stretch of disused canal flanked by ditches, neutral grassland, scattered scrub and trees, an area of inundation fen and a withy bed. The site is of special interest for its assemblages of nationally rare and scarce invertebrates and nationally	The Wye Valley and Forest of Dean Bat Sites SAC is a site of International value. The Severn Estuary SAC/SPA/Ramsar/SSSI is a site of International value. Walmore Common SPA is a site of International value. Coombe Hill Canal SSSI is a site of National value.

Ecological Feature	Summary of Desk Study Information	Summary of Field Survey Results and Preliminary Valuation
	scarce plants. This site is located approx. 1.9 km north west of Option 2B. There are no statutory designated sites within 2 km of any of the other Scheme options. There are no non-statutory designated sites within 2 km of the Scheme options.	
Terrestrial habitats	There are no recorded ancient woodlands within 1 km of any of the Scheme options, and no ancient or veteran trees within 250 m of any of the Scheme options. Priority habitat records identified during the desk study within 1 km of the Scheme options include: • Deciduous woodland and traditional orchards within each of the Scheme options; • Good Quality Semi-improved Grassland (Lowland Meadows and Pastures) 640 m west; and • Coastal and Floodplain Grazing Marsh approximately 680 m west.	The Scheme is located within a low-lying, mainly agricultural landscape to the north west of Cheltenham. The 250 m study areas for all options are dominated by large arable fields, improved grasslands and poor semi improved grasslands. These habitats exist either side of the M5 motorway, which runs south west to north east, and the A4019, which runs north west to south east. The study area is also bisected by the River Chelt, which flows through the area from east to west. The fields across the study area are typically bordered by species-poor hedgerows. Results from the hedgerow surveys indicate no 'important' hedgerows, based on ecological criteria. The study area is dominated by arable fields and poor-quality grassland, with sparsely distributed, small areas of priority habitats. Although primarily species-poor, the hedgerow network adds to the value of this feature through the provision of ecological connectivity. Taking all of this into consideration, Terrestrial Habitats have been ascribed a value of Local.
Bats	No EPS licences for bats were identified within the study area for Options 2, 2A and 2B. GCER provided details of at least five bat species that have been recorded within the study area: • Brown long-eared bat; • Common pipistrelle; • Daubenton's bat; • Lesser horseshoe; and • Soprano pipistrelle.	The habitats recorded within the study area are likely to be suitable for foraging and commuting bats, including the Annex II species (lesser horseshoe, greater horseshoe, barbastelle and Bechstein's bat). Key areas are likely to include the River Chelt habitat corridor; the woodland plantations along the M5 corridor; the traditional orchards; and the areas characterised by smaller field patterns and less intensive agricultural use. The following is a summary of building bat roost survey results to-date: • Confirmed roosts in 33 buildings – species confirmed so far comprise; brown long-eared bat, common pipistrelle,

Ecological Feature	Summary of Desk Study Information	Summary of Field Survey Results and Preliminary Valuation
		soprano pipistrelle, lesser horseshoe, Natterer's bat and whiskered bat; • High potential for roosts in 4 buildings; • Moderate potential for roosts in 21 buildings; • Low potential for roosts in 30 buildings; • Negligible potential for roosts in 37 buildings. There are a large number of trees across the study area, many of which could potentially contain bat roosts. The following is a summary of tree bat roost survey results to-date: • Confirmed roost in four trees – species confirmed so far comprise noctule bat, barbastelle bat and Bechstein's bat; • High potential for roosts in 13 trees; • Moderate potential for roosts in 35 trees; • Low potential for roosts in 126 trees and 30 tree groups. No evidence of hibernating bats was observed during the tree hibernation survey. Analysis of static detector data completed to-date has focused on checking and analysing passes identified by Kaleidoscope Pro autoID as Annex II species. Based on the preliminary results, Annex II bat species were recorded at all static locations, with the exception of one location which was only surveyed for two months, due to land access restrictions and detector failure. Lesser horseshoe bats were the most frequently recorded Annex II species and found at all static locations except for the one as mentioned above. Barbastelle bats and greater horseshoe bats have also been frequently recorded from the static surveys. Transect survey results are currently being analysed. Based on the information that is currently available concerning the distribution and abundance of confirmed and potential bat roosts within the study area, the availability of suitable foraging and commuting habitats and the assemblage of species already

Ecological Feature	Summary of Desk Study Information	Summary of Field Survey Results and Preliminary Valuation
		recorded, bats have been ascribed a preliminary, value of Regional. This will be refined following further surveys.
Dormouse	GCER provided one record of dormouse within the study area; from a hedgerow to the northwest of Gallagher Retail Park (at the south east end of the A4019 corridor).	Suitable habitat for dormouse was observed during the walkover survey, including woodland and hedgerows. During the dormouse surveys carried out in 2019, no evidence of dormouse was identified. Therefore, dormice are considered likely to be absent from within the study area.
Badger	GCER provided five records of badger within the study area.	Signs of badger presence have been recorded during the walkover survey and other ongoing surveys, including the presence of several setts. There are suitable foraging habitats for badger throughout the study area and numerous habitats not yet subject to a thorough search, which could contain badger setts. Badger has been ascribed no value as it is not a species of nature conservation concern.
Otter	GCER provided three records of otter within the study area. These were on the River Chelt at Withy Bridge, at Piffs Elm and immediately south west of M5 Junction 10.	Suitable riparian habitats for otter have been recorded within the study area during the walkover surveys, primarily along the River Chelt and connecting habitats including minor watercourses and ponds. During otter surveys carried out between September and November 2019, presence or potential presence of otter was recorded along the River Chelt, the Leigh Brook and two minor watercourses. Monitoring has been undertaken at five potential otter resting sites, four along the River Chelt and one along a minor watercourse. The footage/ field notes are currently being analysed. Given that otter is known to use the River Chelt and assuming that this species is also present in other suitable habitats within the study area, and that this is of importance in maintaining the distribution of the species across Gloucestershire, otter has been ascribed a preliminary, precautionary value of County. This value will be refined following further surveys in 2020 and analysis of data.

Ecological Feature	Summary of Desk Study Information	Summary of Field Survey Results and Preliminary Valuation
Water vole	There are no previous records or incidental observations of water vole within the study area.	Suitable habitat for water vole was identified during the habitat suitability assessment surveys undertaken in 2019. Subsequently, two presence/ likely absence surveys have been undertaken (in September 2019 and June 2020) at the River Chelt and a minor watercourse. No signs of water vole were observed during either of the surveys at either location. Based on the results of the habitat suitability assessments and presence/ likely absence surveys carried out in 2019 and 2020 (and the lack of records within the area), it is considered that water vole is likely absent from the study area.
Other notable mammals	GCER provided details of one other notable mammal species – hedgehog, which has been recorded at many locations across the study area.	Two other notable mammals have been observed within the study area during ongoing surveys: • Brown hare – recorded on the Boddington Estate; and • Polecat – dead on road near Hayden. Suitable habitats for these species have been observed throughout the study area. No further surveys for notable mammal species are considered necessary, as the assessment will be based on the assumption that hedgehog, brown hare and polecat occur intermittently in suitable habitats throughout the study area and that these are the only other notable mammal species present. In accordance with this assumption, other notable mammals have been ascribed a value of Local.
Breeding and wintering birds	GCER provided details of 31 priority bird species which have been recorded within the study area. These include: barn owl, black-headed gull, bullfinch, common gull, cuckoo, dunnock, great black-backed gull, grey wagtail, herring gull, house martin, house sparrow, kestrel, kingfisher, lesser black-backed gull, linnet, mallard, meadow pipit, merlin, mistle thrush, peregrine falcon, red kite, redwing, skylark, snipe, song thrush, starling, stock dove, swift, tawny owl, willow warbler and yellowhammer.	A number of priority bird species were observed during the walkover survey. These included two species not present in the GCER records: yellow wagtail and lapwing. A red kite was also observed flying overhead at Hayden Hill Fruit Farm and a barn owl roost/ nest site was found in a tree near Withybridge Lane. Eight further barn owl sightings have been made during other ongoing surveys. The study area contains suitable breeding and wintering habitats for a range of priority bird species.

Ecological Feature	Summary of Desk Study Information	Summary of Field Survey Results and Preliminary Valuation
		The data from bird surveys carried out to-date is still being processed and analysed. Therefore, the total number of notable species recorded during the breeding and wintering surveys is not yet available. However, from the results of the surveys carried out to-date, it is known that two qualifying species of the Severn Estuary SPA have been recorded; lapwing (two individuals) and mallard. Given the low numbers recorded and the distance from the SPA, it is considered unlikely that the lapwing or mallard recorded within the study area are a significant component of the SPA qualifying feature populations. Based on the information that is currently available concerning the distribution of suitable habitats and priority species previously recorded within the study area, the breeding and wintering bird assemblages have been ascribed a preliminary, precautionary value of Regional. This value will be refined following analysis of the existing survey data, and this ecological feature will likely be de-valued to County or Local value.
Reptiles	GCER provided records of two reptile species within the study area, a common lizard and a slow worm.	A grass snake and a common lizard were recorded during the walkover surveys, and a juvenile slow worm was recorded during a bird survey. Suitable habitats for grass snake, slow worm and common lizard are scattered throughout the study area. During the reptile surveys no reptiles were recorded within the study area. Given the low numbers of reptiles recorded incidentally, reptiles have been ascribed a preliminary value of Local.
Great crested newt (and other amphibians)	No Natural England great crested newt EPS licences were identified within the study area. GCER provided two records of great crested newt within the study area (one from approximately 400 m south, and one from approximately 1 km west). GCER also provided one record of common toad from Hayden Road Allotments.	A total of 19 waterbodies that could support breeding populations of great crested newt have been identified within 500 m of the remaining Scheme options. Great crested newt presence has been confirmed (positive eDNA result) at six waterbodies; likely absence (negative eDNA result) has been recorded at six waterbodies; one waterbody was not suitable for great crested newts (dry at the time of the survey); and six waterbodies have not yet been surveyed do to access restrictions.

Ecological Feature	Summary of Desk Study Information	Summary of Field Survey Results and Preliminary Valuation
		Given that the study area is already known to support at least two great crested newt metapopulations and that further survey may confirm the presence of more, this area is likely to be of importance in maintaining the distribution of this species across Gloucestershire. Great crested newt has therefore been ascribed a preliminary value of County. Common toad is assumed to occur in suitable habitats throughout the study area. Common toad has been ascribed a value of Local.
Terrestrial invertebrates	GCER provided details of six notable terrestrial invertebrate species recorded within the study area. These were all recorded towards the south east end of the A4019 corridor: cinnabar moth, ghost moth, mouse moth, brown-spot pinion (moth), deep-brown dart (moth) and green-brindled crescent (moth). These species are typically associated with a range of habitats, including grasslands, woodlands, hedgerows and gardens. The most selective of these species is the cinnabar moth, which requires open grassy habitats with common ragwort.	While notable species, such as the moths listed from the desk study, may occur occasionally, the intensive agricultural habitats which dominate most of the study area are unlikely to support notable assemblages of terrestrial invertebrates. However, traditional orchards at Hayden Hill Fruit Farm and Millhouse Farm could potentially support noble chafer beetle. The Severn and Avon Vales National Character Area[75] is a stronghold for this priority species, which requires decaying wood on fruit trees for the larval stage of its life-cycle. Assuming the presence of a key population of noble chafer at Hayden Hill Fruit Farm and Millhouse Farm, the terrestrial invertebrate assemblage has been ascribed a precautionary value of County.
Plants	GCER provided no records of protected or notable plant species within the study area.	Only common and widespread plant species were observed during the walkover survey. The intensive agricultural habitats which dominate the study area are unlikely to support notable plant species. While the small areas of semi-improved grassland could potentially support notable plant species, the absence of any observations during the walkover survey (which was undertaken at an optimal time of year for botanical survey), indicates that important populations of such species are likely to be absent.

[75] http://publications.naturalengland.org.uk/publication/1831421?map=true&category=587130 [Accessed 02/09/19].

Ecological Feature	Summary of Desk Study Information	Summary of Field Survey Results and Preliminary Valuation
		Plant species have been ascribed no value and are not considered further for assessment. Although no notable plant species were observed during the walkover survey, Himalayan balsam was recorded at multiple locations. This species does not have any nature conservation value but is an invasive non-native species subject to legal control under the Wildlife and Countryside Act 1981 (as amended). This makes it illegal to plant or otherwise cause Himalayan balsam to grow in the wild.
Aquatic habitats and species	The desk study identified eight watercourses within 150 m of the Scheme; one Main River and seven Ordinary Watercourses, as summarised below: • River Chelt (Main River) – located within the study area and crossed by the existing M5 alignment at SO 90020 24812. New crossing proposed at SO 90743 24593. • Unnamed tributary of River Chelt 1 (Ordinary Watercourse) – located within the study area and crossed by the existing M5 alignment at SO 89952 24645. Additional interaction with route options at existing B4634 crossing at SO 90366 23844. • Unnamed tributary of River Chelt 2 (Ordinary Watercourse) – located within the study area. Potential interaction with route options at SO 90064 25189. • Leigh Brook (Ordinary Watercourse within study area, Main River approximately 2 km downstream) – located within the study area and crossed by the existing M5 alignment at SO 90759 26016. • Unnamed tributary of Leigh Brook (Ordinary Watercourse) – located within the study area. Interaction with route options at existing A4019 crossings at SO 90710 25443 and SO 91017 25226. • Field drain 1 (Ordinary Watercourse) – located within the study area. New crossing proposed at SO 90870 24886. • Field drain 2 (Ordinary Watercourse) – located within the study area. New crossing proposed at SO 90616 23905.	Walkover survey identified the River Chelt as having a range of flow types, bed substrates and vegetation. As such it is likely to support a wide variety of aquatic species. Subsequently, further surveys have been undertaken. The results of these surveys are yet to be analysed in detail. Some suitable habitat for white-clawed crayfish was identified within tree/ riparian vegetation roots. One signal crayfish was identified during the survey. The survey of Leigh Brook within the study area identified it as a heavily modified channel/ ditch within the headwaters of the catchment. The channel exhibits limited habitat complexity and is choked with terrestrial herbs and scrub (indicating the channel is ephemeral). Given that flows are limited, and the channel is choked, it is not considered suitable for fish within the study area but could provide some habitat value for aquatic invertebrates. Initial review of macrophyte survey data indicate that <0.1% of the vegetation cover within the Leigh Brook is comprised of aquatic species. The remainder of the watercourses were observed to be minor tributary systems and heavily managed drainage ditches with limited habitat complexity and straightened planforms. They are typically choked with terrestrial herbs and scrub (indicating their ephemeral nature) and/ or shaded by trees. The following valuations have been ascribed to the watercourses: • River Chelt – County value

Ecological Feature	Summary of Desk Study Information	Summary of Field Survey Results and Preliminary Valuation
	• Field drain 3 (Ordinary Watercourse) - located within the study area. New crossing at SO 90464 23864. The desk study did not identify any standing waterbodies within 150 m of the three options, although one pond (P23) is located just outside the 150 m study area. No background records are available for this waterbody. One Environment Agency fish monitoring site, three macroinvertebrate monitoring sites and one macrophyte monitoring site with recent survey data are present within the background records study area.	• Unnamed tributary of River Chelt 1 – Local value • Unnamed tributary of River Chelt 2 – Local value • Leigh Brook – Local value • Unnamed tributary of Leigh Brook – Local value • Field drain 1 – Local value • Field drain 2 – Local value • Field drain 3 – Local value These values will be refined following analysis of the completed RHS, RCS, fish and macrophyte surveys and scheduled aquatic invertebrate survey. In the absence of detailed pond survey, P23 has been ascribed an assumed value (based on the predominantly agricultural setting, the absence of any site designations and professional judgement in line with findings from previous highway schemes). It is considered that P23 is likely to be of Local value (this excludes any valuation for GCN potential).

7.5. Assumptions and Limitations

7.5.1. GCER do not hold exhaustive records of all the species that occur within a given area. Therefore, the absence of records for a particular species does not demonstrate that the species is absent. Similarly, the Woodland Trust's Ancient Tree inventory is not an exhaustive list and other ancient and veteran trees may be present in an area. These limitations have been factored into the assessment, which does not rely solely on desk study data.

7.5.2. The desk study search for waterbodies (including ponds and wet ditches) within 500 m of the Site was undertaken by using Ordnance Survey plans and aerial photographs only. These sources may not show all waterbodies within 500 m of the Site boundary and therefore some waterbodies may not have been identified and have not been included in the surveys.

7.5.3. Ecological surveys are limited by factors which affect the presence of plants and animals such as the time of year, migration patterns and behaviour. The ecological surveys undertaken to-date have not therefore produced a complete list of plants and animals and the absence of evidence of any particular species should not be taken as conclusive proof that the species is not present or that it will not be present in the future.

7.5.4. Full access to the study area was not available for the field surveys, due to landowners refusing access. If access can be obtained, these areas will need to be surveyed to enable a more robust assessment for later stages of the project.

7.5.5. Initial habitat suitability assessment surveys for otter and water vole have not been possible at a number of waterbodies. Based on the lack of water vole evidence elsewhere within the study area, the presence of water vole is considered unlikely here. Furthermore, in relation to water vole and otter, these waterbodies are some distance from the Scheme and, in most cases, separated from it by built up areas. On this basis, impacts to otter and water vole, in the unlikely event that they are present, are considered unlikely. Access to these locations will therefore not be pursued in relation to these species, although should access be gained for other species (great crested newts for example) then consideration would be given to otter and water vole. In a small number of areas, access was restricted due to steep riverbanks, high/ fast flowing water levels or dense vegetation. Where possible, these habitats were surveyed using binoculars from safe, accessible locations, and this is therefore not considered to be a significant limitation.

7.5.6. During the potential otter resting site monitoring surveys, it was not possible to deploy trail cameras at two locations due to the potential for theft and high water levels. Instead, each location was visited five times during each four-week survey period to search for signs of otter. This level of survey data is considered sufficient to adequately assess activity levels, so this is not considered to be a significant limitation.

7.5.7. Due to the COVID-19 situation, and in discussion with the client, it was decided to stop surveying towards the end of March 2019 and into April 2019. This had the following impacts on planned surveys:

- The bat transect surveys and static detector surveys scheduled for April could not take place;
- Only half of the wintering bird transects were surveyed in March, and no breeding bird survey could be undertaken in April. The breeding bird surveys in May 2020 started later than usual (generally about an hour), as no overnight stays were permitted and surveyors had to travel to site from further afield;
- Spring aquatic invertebrate surveys could not take place.

7.5.8. Surveys restarted in May 2020, with extra precautions being implemented to ensure government guidelines were followed in relation to social distancing etc. At this point, it is not anticipated that the loss of late March/ April survey data for the above species groups will significantly reduce the robustness of the ES.

7.5.9. Regarding bats, a large amount of survey data has been collected for this species group in 2019 and is continuing to be collected in 2020. Missing one month of survey data is therefore not considered to be a significant limitation. However, the data will be reviewed

later in 2020 and Natural England will be consulted as to whether it is considered necessary to fill any early-season gaps in 2021.

7.5.10. Only a small proportion of the wintering bird season was missed, and the results collected for the remainder of the season indicate that the study area is not of particular value to wintering birds. Any results collected during late March would be unlikely to alter this conclusion.

7.5.11. Missing the April breeding bird surveys may have resulted in missing breeding behaviour of some early breeding species, resulting in them being recorded as possible or probable breeding, instead of confirmed breeding. This is not considered to be a significant limitation.

7.5.12. Surveys for aquatic invertebrates were undertaken in autumn 2020, as the next suitable season in which aquatic invertebrate surveys can take place.

7.5.13. Notwithstanding the access limitations, and the limitations described due to COVID-19, a number of surveys are currently incomplete and have been continued in 2020 and 2021 to ensure a robust baseline is established. These limitations have been partially addressed in the preliminary valuation undertaken to-date by application of the precautionary principle.

7.6. Potential Impacts

7.6.1. The assessment has followed guidance from CIEEM[76] and LA 108[77]. The significance of effects on ecological features identified has been categorised where appropriate according to LA 108[78] and considers both on-site impacts and those that may occur to adjacent and more distant ecological features.

7.6.2. The level of impact has been determined by the assessment of the following characteristics:

- Positive or negative (e.g. adverse/beneficial);
- Duration (e.g. permanent/temporary);
- Reversibility (e.g. irreversible/reversible)
- Extent/magnitude;
- Frequency and timing.

7.6.3. The level of impacts on biodiversity resources shall be reported in accordance with the criteria provided in LA 108, and in accordance with CIEEM guidelines.

7.6.4. The importance of the resource and level of impact has been used to determine the significance of effect using the matrix shown in LA 108[79].

7.6.5. Significant effects typically comprise effects that remain within the moderate, large or very large categories once mitigation has been taken into account.

7.6.6. The remainder of this section of the chapter characterises the potential impacts and the subsequent potential effects (both positive and negative) of the Scheme on the important ecological features within the study area in the absence of mitigation. The following potential impacts have been identified. It should be noted that this is not an exhaustive list, and will be updated as the assessment continues.

Construction Impacts

- Permanent habitat loss (e.g. loss of hibernacula, basking sites, or foraging habitat used by protected and notable species, or the loss of priority habitat);

[76] CIEEM (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester.
[77] LA 108 Biodiversity (Highways England, March 2020). [Online]. [Accessed October 2020]. Available from: https://www.standardsforhighways.co.uk/dmrb/search?discipline=SUSTAINABILITY_AND_ENVIRONMENT.
[78] LA 108 Biodiversity (Highways England, March 2020). [Online]. [Accessed October 2020]. Available from: https://www.standardsforhighways.co.uk/dmrb/search?discipline=SUSTAINABILITY_AND_ENVIRONMENT.
[79] LA 108 Biodiversity (Highways England, March 2020). [Online]. [Accessed October 2020]. Available from: https://www.standardsforhighways.co.uk/dmrb/search?discipline=SUSTAINABILITY_AND_ENVIRONMENT.

- Temporary habitat loss (e.g. land used during construction that is subsequently to be restored);
- Habitat degradation (e.g. through sediment release, pollution events and dust);
- Habitat fragmentation affecting movements of protected and notable species;
- Injury or mortality of protected and notable species;
- Disturbance from noise and vibration to protected and notable species; and
- Changes to hydrological conditions.

Operational Impacts

- Injury and mortality of protected and priority species from collision with vehicles;
- Disturbance from noise and vibration to protected and notable species; and
- Pollution events.

Designated Sites

Wye Valley and Forest of Dean Bat Sites SAC

7.6.7. At a distance of over 20 km, there is no potential for the Scheme to directly affect the Wye Valley and Forest of Dean Bat Sites SAC. There is, however, potential for qualifying bat species populations associated with the SAC to be affected by Scheme-related habitat loss/degradation/fragmentation, injury/mortality and disturbance, if those SAC bat populations also use areas of habitat that would be affected by the Scheme.

7.6.8. The BCT[80] has defined core sustenance zones (CSZs) for different bat species, which are "the area surrounding a communal bat roost within which habitat availability and quality will have a significant influence on the resilience and conservation status of the colony using the roost." For lesser and greater horseshoe bats, BCT estimates CSVs of 2 km and 3 km respectively. Confidence in this zone size is 'Good' for lesser horseshoe and 'Moderate' for greater horseshoe.

7.6.9. Even if the CSZs for these species were several times larger, it is considered highly unlikely that the lesser and greater horseshoe bat populations associated with the Wye Valley and Forest of Dean Bat Sites SAC would utilise habitats in the vicinity of the Scheme to the extent that the SAC would be adversely affected. Therefore, the impact is predicted to be **Neutral** for this feature (during construction and operation) and it is proposed to scope this designated site out of the EIA.

7.6.10. This assessment will be documented in a Habitats Regulations Assessment (HRA) Screening report.

Severn Estuary SAC/SPA/Ramsar/SSSI

7.6.11. Although there is a direct hydrological connection between all the Scheme options and the Severn Estuary SAC/SPA/Ramsar site/SSSI, at a distance of over 40 km downstream, it is considered that any releases of pollutants during construction or operation of the Scheme would be sufficiently diluted by the time they reached the designated site, that the impact would be **Neutral** (during construction and operation) and it is proposed to scope this designated site out of the EIA.

7.6.12. This assessment will be documented in a HRA Screening report.

Walmore Common SPA

7.6.13. The agricultural grassland habitats that would be affected by the Scheme are suitable for use by the Bewick's swan population associated with this SPA. However, no Bewick's swan were observed within the survey area during the monthly wintering and migratory bird surveys that were undertaken from September 2019 to March 2020 inclusive, indicating that this species does not regularly use or is dependent on the habitat in the

[80] Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London.

vicinity of the Scheme. This is supported by the existing literature on Bewick's swan distribution in the UK[81] which does not identify the survey area as a key foraging or roosting area.

7.6.14. Therefore, the impact is predicted to be **Neutral** for this feature (during construction and operation) and it is proposed to scope this designated site out of the EIA.

7.6.15. This assessment will be documented in a HRA Screening report.

Coombe Hill Canal SSSI

7.6.16. Coombe Hill Canal SSSI is only within the study area for Option 2B, the north eastern end of the site falling just within the 2 km zone. Given the nature of this predominantly wetland SSSI, its distance from the Scheme and the absence of any direct hydrological connections, the impact is predicted to be **Neutral** for this feature (during construction and operation) and it is proposed to scope this designated site out of the EIA.

Terrestrial and aquatic habitats and species

7.6.17. All of the options would result in permanent losses and fragmentation of habitats. Remaining habitats could potentially be degraded by releases of dust, sediment and other pollutants during construction and pollution events during operation. These habitats could also potentially be affected by changes to the prevailing hydrological conditions. Overall, the Scheme could potentially have a **Slight Adverse** effect on terrestrial habitats during construction and operation.

7.6.18. Although the impacts have not been characterised in detail at this stage, there is potential for **significant effects** (i.e. moderate significance or above) on the following ecological features as a result of their ecological value being greater than Local and the predicted impacts of the Scheme:

- Bats;
- Otter;
- Breeding and wintering birds;
- Great crested newt;
- River Chelt and associated habitats and species.

7.6.19. Terrestrial invertebrates have been assigned a precautionary value of County, assuming the presence of a key population of noble chafer at Hayden Hill Fruit Farm and Millhouse Farm. However, despite the potential presence of this species, none of the Scheme options would impact the suitable habitat and the impact would be **Neutral** (during construction and operation). It is proposed to scope terrestrial invertebrates out of the EIA.

7.7. Potential Effects and Mitigation Measures

Avoidance

7.7.1. Where feasible, the preferred approach in the mitigation hierarchy is avoidance of impacts. In this case, where there are multiple Scheme options under consideration, it may be possible to avoid certain impacts by not selecting the option(s) with which those impacts are associated.

General mitigation measures

7.7.2. Many of the potential impacts identified could be mitigated by one or more of the following general measures:

- Design amendments to minimise habitat loss;

[81] Robinson, JA, K Colhoun, JG McElwaine & EC Rees (2004). Bewick's Swan *Cygnus columbianus bewickii* (Northwest Europe population) in Britain and Ireland 1960/61 – 1999/2000. Waterbird Review Series, The Wildfowl & Wetlands Trust/Joint Nature Conservation Committee, Slimbridge.

- Design amendments to incorporate habitat connectivity features, such as habitat corridors, wildlife underpasses, and/or green bridges;
- Establishment of an appropriately sized, resourced and experienced site environmental management team (including at least one Ecological Clerk of Works (ECoW)) to ensure effective implementation of all environmental mitigation;
- Ecological briefings/ toolbox talks for all site operatives to make them aware of relevant constraints and requirements prior to commencing work on the Scheme;
- Clear demarcation (i.e. fencing) of retained habitats and no allowance of vehicles or storage of materials within these areas;
- Use of sediment control measures during construction, such as:
- Timing works to avoid exposure of soil during autumn/winter;
- Seeding/planting exposed topsoil at earliest opportunity;
- Use of silt fencing, drainage ditches, attenuation ponds, etc;
- Use of pollution control measures during construction, such as:
- Use of low emission plant;
- Regular maintenance and inspection of machinery;
- Use of designated, bunded areas away from sensitive ecological features for fuel storage and refuelling (i.e. following Environment Agency Pollution Prevention Guidance (PPGs)[82] and the Construction Industry Research and Information Association (CIRIA) guidance on the control of water pollution from construction sites[83]);
- Location of haul roads away from sensitive features and use of dust suppression measures during dry periods;
- Covering excavations overnight or incorporating features such as ramps to prevent animals getting trapped;
- Designing the construction and operation drainage to maintain or enhance[84] the existing hydrological conditions; and
- Designing the operation drainage to minimise the risk of pollution from the road surface coming into contact with sensitive habitats.

Feature specific mitigation and compensation measures

7.7.3. In addition to the general measures set out in the previous section, there are further measures which could be employed to mitigate or offset potential impacts for specific ecological features. These measures are described for the relevant features in the subsections below, along with measures to ensure legal compliance with regard to badger and Himalayan balsam.

7.7.4. As with the rest of this assessment, these measures are based on incomplete information regarding the distribution and abundance of ecological features within the study area. Refinement of these mitigation measures will be required once further survey information becomes available.

[82] Note that a review of the PPGs is currently underway, resulting in a replacement guidance series for Scotland, Northern Ireland and Wales (Guidance for Pollution Prevention (GPPs)). In the absence of the new guidance in England the existing (withdrawn) PPGs provide appropriate guidance to be followed. If individual PPGs have been superseded with a GPP, it is recommended that the newer guidance is used despite not being compiled by the Environment Agency and the https://www.gov.uk/guidance/pollution-prevention-for-businesses website is consulted.
[83] The CIRIA documents are a series of publications developed by the Construction Industry Research and Information Association. Each document is targeted at a particular type of business or activity and covers environmental good practice to minimise pollution. Particular attention should be given to CIRIA C532 (Control of water pollution from construction sites, 2001).
[84] Enhancement in this context means the enhancement of one or more features' ecological condition or value, without detriment to other ecological features.

Bats

7.7.5. Alternative roosts sites are likely to be necessary to replace any building or tree roosts lost or isolated as a result of the Scheme. This is likely to be a condition of the EPS licence that would be required to legally destroy the roosts.

7.7.6. Creation of suitable foraging and commuting habitat is also likely to be necessary to provide habitat connectivity for the new roost sites and offset losses within the Scheme footprint. These should seek to minimise the incidence of bats crossing roads at vehicle height.

7.7.7. Any destruction of bat roosts must be undertaken in accordance with the timing and methods specified by the EPS licence for those activities and must be overseen by a suitably qualified and experienced ECoW.

7.7.8. Further construction mitigation measures which may be required in relation to bats include:

- Avoidance of night working during the main bat active season (April to September inclusive);
- Prevention of artificial illumination of roosts and key foraging/commuting habitats; and
- Minimisation of noise and vibration in the vicinity of roosts.

Badger

7.7.9. Alternative sett provision is likely to be necessary if construction of the Scheme were to require closure of any active main setts. This is likely to be a condition of the licence that would be required to legally destroy any active badger setts.

7.7.10. Any closure of badger setts must be undertaken in accordance with the timing (usually between 1 July and 30 November, except in exceptional circumstances) and methods specified by the licence for those activities and must be overseen by a suitably qualified and experienced ECoW.

7.7.11. Given the potential for new setts to be excavated in a short space of time, it is necessary for the Scheme footprint to be re-surveyed for badger setts several weeks prior to commencement of construction.

7.7.12. It may be appropriate to install badger proof fencing to prevent badgers from reaching the live carriageway. Underpasses may also be appropriate to ensure that badgers can continue to move about the landscape to access their setts and foraging areas.

Otter

7.7.13. In the unlikely event that an otter holt is present within a section of watercourse affected by the works and it is not possible to amend the design to avoid it, alternative holt provision is likely to be required. This is likely to be a condition of the EPS licence that would be required to legally destroy the holt.

7.7.14. If any sections of watercourse used by otter are to be culverted, the design of the culvert will need to be such that the passage of otters along the watercourse is not obstructed.

7.7.15. Any destruction of otter holts must be undertaken in accordance with the timing and methods specified by the EPS licence for those activities and must be overseen by a suitably qualified and experienced ECoW.

7.7.16. Further construction mitigation measures which may be required in relation to otter include:

- Establishment of buffer zones around watercourses in which construction and laydown activities are prohibited;
- Prevention of artificial illumination of watercourses; and
- Minimisation of noise and vibration in the vicinity of holts.

7.7.17. It may be appropriate to install otter proof fencing to prevent otters from reaching the live carriageway.

Breeding & Wintering Birds

7.7.18. In order to avoid destruction of active bird nests, clearance of suitable bird nesting habitat should be undertaken outside of the main bird nesting season (generally March to August inclusive in southern England). Any clearance during this period must be preceded by a nesting bird check and overseen by an ECoW. In the event that active bird nests are found, an appropriate buffer zone must be established around the nest and clearance activities delayed within that zone until the nesting attempt has reached its natural conclusion.

7.7.19. In order to prevent disturbance of nesting Schedule 1 bird species (e.g. barn owl), it may be necessary to restrict construction activities in the vicinity of Schedule 1 bird nests while they are active.

7.7.20. Alternative habitat provision is likely to be required to compensate for the loss of nesting and foraging habitats, particularly for sensitive species with specialist requirements, such as barn owl.

Reptiles

7.7.21. Where suitable reptile habitats are to be cleared, measures will need to be taken to displace or translocate reptiles from the affected area prior to commencement of construction. It is likely that a suitable receptor area(s) would also have to be created or enhanced in order to accommodate the translocated/ displaced animals and that herptile fencing would have to be installed to prevent reptiles from returning to the construction area.

7.7.22. Any translocation, displacement or habitat destruction activities must be undertaken at an appropriate time of year, using appropriate methods and must be overseen by a suitably qualified and experienced ECoW.

Great Crested Newt

7.7.23. If any breeding ponds or suitable terrestrial habitats within 500 m of breeding ponds are to be affected by the works and it is not possible to amend the design to avoid them, measures will need to be taken to displace or translocate great crested newts from the affected area prior to commencement of construction. Such activities would require an EPS licence and compensatory habitat would have to be provided (including ponds if any ponds are to be lost). This habitat would need to be established prior to any translocation and it is likely that herptile fencing would have to be installed to prevent newts from returning to the construction area.

7.7.24. Any translocation/ displacement of great crested newts or destruction great crested newt habitat must be undertaken in accordance with the timing and methods specified by the EPS licence for those activities and must be overseen by a suitably qualified and experienced ECoW.

7.7.25. It may be possible to avoid some of the mitigation measures described above under the District Level Licensing Scheme, if this option is pursued. This scheme can be used by developers, for a fee, and focuses on landscape scale compensation for great crested newts, allowing greater than ‘usual’ impacts on individual animals on a development site.

Common Toad

7.7.26. The mitigation measures specified for great crested newt would also benefit common toad. Any toads encountered during any great crested newt translocations could be moved out of the construction area at the same time.

Himalayan Balsam

7.7.27. Specific vegetation and soil management measures will be required during construction to prevent the spread of Himalayan balsam and any other invasive non-native plant species (INNS) present within the Scheme footprint and ensure compliance with the Wildlife and Countryside Act 1981 (as amended).

7.7.28. The seeds of Himalayan balsam can be ejected over 7 m from the parent plant and remain viable for two years. In addition to the requirements of the WCA, soils containing

Himalayan balsam seeds are classified as controlled waste by the Environmental Protection Act 1990.

7.7.29. A pre-construction INNS survey should be undertaken to enable mapping and demarcation of all stands of INNS within the Scheme footprint and identification of an appropriate control/eradication strategy. Biosecurity protocols should be followed to prevent the spread of propagules, such as restricting access to the demarcated areas and requiring boots and machinery to be cleaned before leaving these areas.

Aquatic Habitats & Species

7.7.30. The design will need to consider the interaction of the Scheme with the River Chelt and other watercourses. Single span bridges should be the preferred crossing type rather than culverts as they typically have less effect on watercourse form and ecological function. Bridges have the least impact on the natural fluvial regime and provided greater opportunity for maintaining existing in-stream and bank side habitat structure. Sediment transport and migration of aquatic species is also less likely to be negatively affected.

7.7.31. If a clear span structure is not technically feasible or economically viable (e.g. where culverts already exist under the main M5 carriageway), a closed culvert is likely to be required. Key considerations in environmentally sensitive culvert design are:

- Provision of embedded culvert inverts for all box culverts and piped culverts to allow for formation of a natural watercourse bed (culvert invert to a depth of at least 0.15 m to 0.3 m below existing bed level) and to reduce the potential for significant habitat severance and effects on fish passage;
- Maintenance of the existing channel gradient to avoid erosion at the upstream or downstream end of a culvert;
- Avoidance of reduction of watercourse length through shortening of watercourse planform and minimisation of culvert length through adoption of a perpendicular alignment to the highway and use of wingwalls;
- Minimising impact of the structure on natural flow and sediment process during construction and operation. For instance, an open arc structure that avoids disturbing the natural bed of the river is preferred to a box culvert;
- The allowance for the appropriate conveyance of water and sediment for a range of flows (including at low flow conditions). Flow rates and depths during normal and low flows will need to be conducive to wildlife requirements such as fish passage; and
- Capacity may be required for environmental mitigation (e.g. mammal shelves and ensuring natural flow/sediment process).

7.7.32. The following key reference sources when designing river crossings should be consulted:

- Environment Agency (2010a). Fluvial Design Guide: Chapter 8 – working in the river channel;
- CIRIA (2010). Culvert design and operation guide (C689). In particular, Chapter 4;
- Advice on minimising impact on fish passage in the Environment Agency's Fish Pass Manual[85]; and
- SEPA's advice on river crossings and position statement on culverting[86].

7.7.33. The interaction of the Scheme with watercourses will also need to consider the requirement for bed and bank reinforcement. Hard engineered bed and bank reinforcement will generally be opposed by the regulator, except at locations where it can be demonstrated that it prevents potential loss of life or is necessary to protect critical

[85] Environment Agency (2010b). Fish Pass Manual. Document – GEHO 0910 BTBP-E-E. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/298053/geho0910btbp-e-e.pdf [Accessed 5 September 2019].
[86] SEPA, 2015. WAT-PS-06-02: Culverting of Watercourses – Position Statement and Supporting Guidance. (Published Nov 2010, second edition) Available at: http://www.sepa.org.uk/media/150919/wat_ps_06_02.pdf [Accessed 5 September 2019] and SEPA, 2010. Engineering in the water environment: good practice guide - River crossings. (Published Nov 2010, second edition) Available at: http://www.sepa.org.uk/media/151036/wat-sg-25.pdf [Accessed 5 September 2019].

infrastructure. 'Softer', bioengineered solutions will in many cases afford appropriate erosion protection and be a cheaper/more sustainable design approach.

7.7.34. The role that vegetation can play in promoting channel stability should be investigated and consultation with a landscape engineer/architect should be undertaken at the earliest opportunity.

7.7.35. Some key documents include:

- Environment Agency guidance on management bank instability and erosion[87]; and
- SEPA, (2008). Engineering in the water environment: good practice guide – Bank Protection.

7.8. Likely Residual Effects

7.8.1. At this stage, it is not possible to detail likely residual effects. However, with further baseline information to enable refinement of the current 'likely worst case' assumptions, considered option selection and commitment to appropriate mitigation, it is plausible that the majority of the residual effects would be reduced to a Neutral level.

7.9. Proposed Level and Scope of Assessment

7.9.1. Further surveys for bats are considered necessary at this stage to establish a robust baseline, and these are described below. Further surveys for badger are also proposed to ensure legal compliance.

7.9.2. For those ponds where great crested newt presence is (or has already been) confirmed, further survey will be required to enable population size classification. Alternatively, it may be possible to make use of the District Licensing Scheme which Gloucestershire has recently become a part of, run by NatureSpace. Use of this scheme would mean that further surveys for great crested newts would not be necessary.

7.9.3. The need for further bird, otter and aquatic species surveys will be reviewed following the completion of surveys and analysis of survey data.

7.9.4. Further surveys for dormouse, water vole and reptiles are not considered necessary at this stage. It is considered that the existing survey information is sufficiently robust to conclude that dormouse and water vole are unlikely to be present within the study area, and that only low numbers of reptiles are present, such that an impact assessment can be reliably informed. The validation surveys proposed below will ensure that the need for further surveys in relation to these species is reviewed should, for example, the habitat increase in suitability for these species prior to application.

7.9.5. No further surveys for notable mammal species or toads are considered necessary, as the assessment will be based on the assumption that these specdies are present in suitable habitats throughout the study area.

Bats

7.9.6. Based on the results from 2019 and 2020 surveys and in order to collect a full suite of survey data to inform impact assessment, the following surveys for bats are proposed.

Bat Building and Tree Survey

7.9.7. All bat building and tree surveys will be undertaken in accordance with the BCT good practice survey guidelines.

7.9.8. Internal inspections of buildings to be demolished, those within 100 m of the Scheme and those at risk from fragmentation within the study area will be undertaken once asbestos

[87] Available at: http://evidence.environment-agency.gov.uk/FCERM/en/SC060065/MeasuresList/M5/M5T6.aspx?pagenum=4 [Accessed 4 September 2019].

information is received and analysed. Internal building inspections are scheduled for winter 2020/2021.

7.9.9. Further building and tree surveys will be required to fill any gaps in the survey data, for example where it has not been possible to undertake any/the requisite number of survey visits of a particular feature due to access restrictions, adverse weather conditions or time constraints.

Advanced Bat Surveys

7.9.10. The requirement for advanced survey techniques for bats in 2021 will be reviewed following the 2020 bat survey season, and analysis of the survey data collected in 2019 and 2020. If deemed to be required, the surveys would focus on Bechstein's bats, as static detector results cannot reliably identify Bechstein's to species level, with the aim of establishing their use of the landscape affected by the Scheme. Atkins would seek to agree the scope of any advanced bat surveys with Natural England.

Badger

7.9.11. A badger survey will be carried out by a suitably experienced ecologist in accordance with good practice guidance[88] and CIEEM competencies for undertaking badger surveys[89]. The extent of the badger survey will be based on the zone of influence for this species and will include all land within the Scheme area and a 50 m buffer extending out in all directions from the Scheme boundary where access allows.

7.10. Validation Surveys

7.10.1. The majority of the ecological survey data collected to support the ES will be from 2019 and 2020. Assuming submission of the DCO application in summer 2022, the survey data from 2019 will be three years old. It is anticipated that some degree of validation surveys may be required to determine whether any of the baseline conditions have changed significantly. Such validation surveys would likely comprise an extended Phase 1 Habitat Survey in the year leading up to the completion of the relevant regulatory assessment. It may also be appropriate to undertake monitoring for bats at some locations to confirm that the baseline data remains robust. Atkins would seek to agree the scope of any validation surveys with Natural England and the Local Planning Authority.

7.11. Proposed Assessment Methodology

7.11.1. The assessment methodology will follow guidance from CIEEM[90] and LA 108[91], as outlined earlier in this chapter.

7.12. Proposed Consultation

7.12.1. Natural England have been given the opportunity to engage ahead of the first options consultation (non-statutory). Natural England will be formally consulted during the pre-application stage through their Discretionary Advice Service (DAS).

7.12.2. As well as Natural England, the following organisations are anticipated to be consulted in relation to biodiversity:

- Gloucestershire County Council ecologists;
- Environment Agency;
- Gloucestershire Wildlife Trust; and

[88] Harris, S., Cresswell, P. & Jefferies, D. (1989) Surveying Badgers. Occasional Publication No.9. The Mammal Society.
[89] CIEEM (2013) Competencies for Species Survey: Badger. The Chartered Institute of Ecology and Environmental Management, Winchester.
[90] CIEEM (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester.
[91] LA 108 Biodiversity (Highways England, March 2020). [Online]. [Accessed October 2020]. Available from: https://www.standardsforhighways.co.uk/dmrb/search?discipline=SUSTAINABILITY_AND_ENVIRONMENT.

- GLNP.

7.12.3. The consultees' views will be taken into account in the impact assessment, final design of the Scheme and its associated mitigation and compensation measures.

7.13. Conclusion

7.13.1. Ecological baseline data associated with the Scheme has been gathered, and further surveys are ongoing or proposed. Available baseline information from desk study and initial field surveys has been used to identify and evaluate ecological features to undertake a preliminary, precautionary assessment of potential impacts for the Scheme.

7.13.2. Numerous potential significant impacts have been identified for all Scheme options in the absence of mitigation in relation to bats, otter, birds, great crested newt and the River Chelt.

7.13.3. A range of measures have been identified to avoid, mitigate and compensate for the effects of these impacts. These include design specifications, construction management requirements and specific nature conservation activities.

7.13.4. With further baseline information to enable refinement of the current 'likely worst case' assumptions, considered option selection and commitment to appropriate mitigation, it is plausible that the majority of the residual effects would be reduced to a Neutral level.

7.13.5. At this stage, it is proposed to scope out the following aspects from the assessment:

- Dormouse and water vole as they are considered unlikely to be present within the study area;
- Designated sites and terrestrial invertebrates as no impacts on these features are anticipated; and
- Badger and plants as these features are not of sufficient ecological value (i.e. less than local ecological value).

7.13.6. Consultation with key stakeholders will be carried out throughout this Preliminary Design Stage of assessment

8. Road Drainage and the Water Environment

8.1. Introduction

8.1.1. This chapter provides the environmental scoping assessment of the Scheme for the water environment. The chapter has been prepared to identify the scope and approach with respect to the assessment of impacts to the water environment that may arise from the construction and operation of the Scheme.

8.1.2. The baseline information is presented to identify the key receptors within the study area which are potentially at risk from the Scheme and to inform the assessment of impacts during construction and operational phases. Potential mitigation is also highlighted.

8.1.3. At PCF Stage 2, baseline information was gathered through desk based assessments and site visits. This information is drawn upon here. Consultation with the Environment Agency was also undertaken to determine compliance with Flood Risk legislation and Water Framework Directive (WFD) compliance.

8.1.4. Additional effects associated with ecology are provided in Chapter 7: Biodiversity, while effects associated with groundwater quality are provided in Chapter 10: Geology and Soils.

8.2. Study Area

8.2.1. The scope of the assessment includes as a minimum, features of the water environment within 1 km of the Scheme. This distance was selected through professional judgement and through the understanding of the local watercourse connectivity which considers 1 km to be an appropriate distance for any potential impacts to be sufficiently dampened (for example, dilution of pollutants).

8.2.2. The study area for flood risk is defined by the hydraulic zone of influence created by the Scheme but as a minimum considers the 1 km buffer.

8.3. Planning policy and topic legislative context

8.3.1. The relevant national policy, legislation and guidance used as the basis for preparation of the scoping report is summarised below:

- National Policy Statement for National Networks (NN NPS, 2014)
  - The Scheme falls within the definition of an NSIP, making the NN NPS the primary planning policy against which an application for a DCO for the Scheme would be judged.
- National Planning Policy Framework (NPPF), 2019
  - Given that the Scheme is an NSIP, the NPPF has the status of a material consideration in planning terms.
- Environmental Protection Act 1990
- Water Industry Act 1991
- Highways Act 1980 (HA 1980)
- National Planning Practice Guidance (NPPG) (2018)
- The Environmental Permitting (England and Wales) Regulations 2016
- Water Act 2003 and Water Act 2014
- Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015
- Water Environment (Water Framework Directive) (England and Wales)

Regulations 2017

- Water Industry Act (1991)
- Flood and Water Management Act 2010
- The Land Drainage Act 1991 and 1994
- Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009
- The Control of Pollution (Oil Storage) (England) Regulations 2001
- Flood Risk Regulations 2009
- The SuDS Manual (CIRIA, 2015)
- Preliminary rainfall runoff management for developments (R&D Technical Report W5074/A/TR/1 Rev E) (January 2012)
- Sewer for Adoption 7th Edition
- The Planning Inspectorate (2017). The Water Framework Directive. Advice note eighteen: The Water Framework Directive (June 2017)

Local planning policy

8.3.2. The adopted JCS provides a co-ordinated strategic plan for the joint administrative area within which the Scheme is located during the period up to 2031. The JCS has an extensive and up-to-date evidence base, including strategic Flood Risk Assessments (FRAs) which provide a detailed assessment of multiple flood sources for specific broad locations within the JCS area.

8.3.3. Whilst the JCS provides the strategic level policies for development in the area, this will be supplemented at individual district level by locally specific plans. In Tewkesbury Borough, the council has begun preparation of the Tewkesbury Borough Plan, which is at a relatively early stage of preparation.

8.3.4. The Flood and Water Management Supplementary Planning Document (SPD) (Tewkesbury Borough Council, 2018) details guidance on the approach that should be taken to manage flood risk and the water environment as part of new development proposals. The SPD highlights the documents that are required to accompany planning applications including site specific FRAs and drainage strategies (incorporating an appropriate approach to surface water drainage including suitability evidence).

8.4. Baseline conditions

8.4.1. This section sets out the baseline conditions of the water environment. At this stage, a high-level, desk-based assessment has been undertaken using publicly available spatial data under the Open Government Licence and from open sources including the Environment Agency and, where appropriate, information from site visits at PCF Stage 2.

Surface Water

8.4.2. Surface watercourses within the study area generally flow from east to west and are located within the Severn River Basin District (RBD), as set out in the Severn River Basin Management Plan (RBMP). Figure 8-1 shows the location of the Scheme in relation to the surface water bodies.

8.4.3. Table 8-1 provides the current WFD status for the four water body catchments spanned by the Scheme.

8.4.4. Within each WFD surface water body catchment, there are numerous Ordinary Watercourses, defined as “every river, stream, ditch, drain, cut, dyke, sluice, sewer (other than a public sewer) and passage through which water flows and which does not form part of a Main River”. Main Rivers fall under the legal powers of the Environment Agency, whereas Ordinary Watercourses come under the remit of Internal Drainage Boards (IDBs) or the Lead Local Flood Authority (LLFA).

8.4.5. The River Chelt is a statutory Main River within the study area and is designated under the WFD as two reaches (Chelt - source to M5, GB109054032820 and Chelt - M5 to conf.

R. Severn, GB109054032810) (Table 8 1)). It is currently crossed by the M5 approximately 0.9 km south of Junction 10 (SO 90019 24822).

Table 8-1 - Summary of status, Reasons for not Achieving Good (RNAG), and objectives for WFD surface water bodies within the study area.

Water Body Name (Water Body ID)	2019 (Cycle 2) Overall Status	HMWB* or Artificial	RNAG	Objective**
Chelt - source to M5 (GB109054032820)	Moderate	HMWB	Mitigation Measures Assessment	Good by 2027 (Disproportionate Burdens)
Chelt - M5 to conf. R. Severn (GB109054032810)	Poor	n/a	Phosphate Macrophytes and Phytobenthos	Good by 2027 (Disproportionate Burdens)
Leigh Bk - source to conf. R. Chelt (GB109054039770)	Moderate	n/a	Phosphate Macrophytes and Phytobenthos	Moderate by 2015 (Unfavourable balance of costs and benefits)
Swilgate - source to conf. R. Avon (GB109054039780)	Moderate	n/a	Phosphate Invertebrates Macrophytes and Phytobenthos Dissolved Oxygen	Good by 2027 (Ecological Recovery Time)

* Heavily Modified Water body

** Objectives as published on Catchment Explorer (Environment Agency 2020a)

8.4.6. The River Swilgate is a statutory Main River within the study area and is designated under the WFD (Swilgate - source to conf. R. Avon, GB109054039780). The watercourse is not directly crossed by the M5 but is within the eastern section of the study area.

8.4.7. The Leigh Brook is crossed by the M5 0.4 km north of Junction 10 (SO 89278 26792). Approximately 2.3 km downstream of the M5 crossing, the watercourse is designated as a Main River. The Leigh Brook is designated under the WFD from its source to its confluence with the River Chelt (Leigh Bk - source to conf. R. Chelt, GB109054039770).

8.4.8. Additionally, there a number of Ordinary Watercourses within the study area which are not individually listed at this stage. None of these watercourses are classified under the WFD.

8.4.9. At this stage of assessment, based on DMRB LA 113, all WFD watercourses within this study area will be classified as having **High or Very High Importance**. All Ordinary Watercourses within the study are will be classified as having **Medium or High Importance**.

Surface water abstractions and discharges

8.4.10. There are two surface water abstractions and 28 surface water discharges within the study area. These are detailed in Appendix A. The dataset presented, includes only current licences. Duplicates and revoked licences are excluded on the assumption these are no longer relevant/active.

Lakes and other surface water features

8.4.11. Lakes are defined as man-made or natural standing water bodies greater than 2 ha (20,000 m^2) with ponds being less than 2 ha (Williams et al., 1999). There are no WFD designated lakes within the 1 km study area, however there are several ponds which will be assessed as part of Chapter 7 (Biodiversity) and where relevant, cross-references will be made.

Groundwater

8.4.12. According to the 1:50,000 mapped geology (BGS, 2020), there is moderate superficial deposit coverage, consisting of Alluvium and Cheltenham Sand and Gravel. The eastern portion of the study area is largely underlain by the Charmouth Mudstone Formation bedrock with the western portion underlain by the Rugby Limestone Member (Figure 8-2).

8.4.13. Lithological descriptions of both superficial and bedrock geology and a generalised geological sequence are provided in Table 8-2. Further detail particularly regarding made ground, soils and local geology can be found in Chapter 10 (Geology and Soils).

Table 8-2 - Generalised geological sequence for the Scheme

Period	Formation / Sub-unit	Lithological Description (BGS, 2020)	Environment Agency Aquifer Designation (Environment Agency, 2020b)
Quaternary	Cheltenham Sand and Gravel	Fine-medium grained of quartroze sand with seams of poorly sorted limestone gravel.	Secondary A
	Alluvium	Unconsolidated clay, sand and silt.	
Triassic	Charmouth Mudstone Formation	Dark grey laminated shales, blue/grey mudstones with local concretions and argillaceous limestone beds with some sandy layers at the base of the stratigraphy.	Secondary Undifferentiated
	Rugby Limestone Member	Grey argillaceous mudstones and limestones.	Secondary A

8.4.14. The study area is underlain by Secondary A and Secondary (undifferentiated) bedrock aquifers (Environment Agency, 2020b). These bedrock aquifer designations are associated with the Charmouth Mudstone Formation and the Rugby Limestone Member. The Scheme is also underlain by discreet areas of Secondary A superficial aquifer associated with the Alluvium and Cheltenham Sand and Gravel. Secondary A aquifers are defined as “permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers”. Secondary B aquifers are defined as “predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering”. Secondary (undifferentiated) aquifers are assigned by the Environment Agency where it has not been possible to attribute either category A or B to a rock type.

8.4.15. There is currently no available site specific information on groundwater levels and flow directions in the study area for the Scheme.

8.4.16. The study area is underlain by two WFD groundwater bodies: (Environment Agency, 2020a) (Figure 8-2).

- Severn Vale - Secondary Combined (GB40902G204900); and
- Warwickshire Avon - Secondary Mudrocks (GB40902G990900).

8.4.17. The details of the status of these groundwater bodies is set out in Table 8-3. For both water bodies, the overall status is good. There are no Groundwater Dependent Terrestrial Ecosystems (GDTEs) within the 1 km study area.

8.4.18. At this stage of assessment, based on DMRB LA 113, all groundwater receptors within this study area will be classified as having **Medium Importance**.

Table 8-3 - Summary of status, RNAG, and objectives for WFD groundwater bodies within the study area.

Water Body Name (Water Body ID)	2019 (Cycle 2) Overall Status	RNAG	Objective
Severn Vale - Secondary Combined (GB40902G204900)	Good	N/A – already at Good status	Achieved at Good
Warwickshire Avon - Secondary Mudrocks (GB40902G990900)	Good	N/A – already at Good status	Achieved at Good

Groundwater abstractions and discharges

8.4.19. There are no Source Protection Zones (SPZ) within the study area.

8.4.20. There are no groundwater abstractions within the study area. However, there is a single groundwater discharge within 1 km of the Scheme.

Flood Risk

Flood risk from watercourses

8.4.21. The study area is drained by the River Chelt (a Main River) and the Leigh Brook (an Ordinary Watercourse). The flood risk to the Scheme arising from these will be assessed, as will the impact of the Scheme on the baseline flood risk. Additional watercourses are present draining the wider rural catchment, and have been identified for water quality and WFD assessment. They do not warrant detailed assessment for flood risk as there is no direct interaction with the Scheme.

8.4.22. The Environment Agency's Flood Map for Planning (Environment Agency, 2020c) identifies areas potentially at risk of flooding from fluvial or tidal sources (Figure 8-3). Areas not within Zone 2 or 3 are by default Flood Zone 1. These zones are defined in the NPPF as follows:

- Flood Zone 1 (Low Probability) comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).
- Flood Zone 2 (Medium Probability) comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.
- Flood Zone 3 (High Probability) comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

8.4.23. The land to the north of the A4019, alongside the Leigh Brook, is identified within Flood Zone 1. However, this relates to the Ordinary Watercourse and it is likely that no flood mapping has been undertaken for that area.

8.4.24. Significant areas of land just south of the A4019 and east of the M5 motorway are classified as Flood Zone 2 and 3. These floodplain areas are associated with the River Chelt. Part of the residential area at Withybridge Gardens, is classified as Flood Zone 3, although some is predicted in Flood Zone 1. To the south of the River Chelt, the floodplain is less extensive and most of the land is identified as Flood Zone 1.

8.4.25. Land to the west of the M5 Junction 10, including the hamlets of Knightsbridge, Coombe Hill and Boddington, is classified as Flood Zone 2, with narrower areas under Flood Zone 3.

8.4.26. The published Environment Agency flood map was last updated in November 2020. The work supporting the update identified a much greater floodplain to the east of the M5 motorway with floodwater being held behind the highway embankment, although that is not shown in the published mapping. The work also identified areas of flood risk

associated with the Leigh Brook, showing large areas at risk of flooding in the 1% annual exceedance probability event (1 in 100-year return period). Again this is not included on the Environment Agency published flood map, as the Leigh Brook is not a Main River.

8.4.27. Flood risk from the River Chelt and Leigh Brook has been identified as a major consideration in this area by the Environment Agency.

8.4.28. At this stage of assessment, based on DMRB LA 113, all flood risk from watercourse receptors within this study area will be classified as having **High or Very High Importance**.

Flood risk from surface water

8.4.29. The Environment Agency's Risk of Flooding from Surface Water map (Figure 8-4) indicates that the risk of surface water flooding is generally low across the area. Medium and high flood risk (i.e. 1% to 3.33% Annual Exceedance Probability (AEP) events respectively) are identified in areas immediately north-east and south-east of the M5 Junction 10, with the highest risk located against the motorway embankment. In particular, surface water appears to pond along the north-east border of the M5 Junction 10 southbound off slip road and extend approximately 750 m north from the junction. This ponding is shown to affect properties on the north bank of the Leigh Brook.

8.4.30. An area of low to high surface water flood risk (0.1% to 3.33% AEP) is located at the M5 motorway crossing of the River Chelt, approximately 800 m south from the M5 Junction 10. Surface water is shown to pond within this area, sitting beside the motorway off either bank and extending south to the unnamed watercourse that passes through the Staverton culvert. This flooding affects several residential properties at Butler's Court.

8.4.31. At this stage of assessment, based on DMRB LA 113, all flood risk from surface water receptors within this study area will be classified as having **High to Very High Importance**.

Tidal flooding

8.4.32. The study area is not indicated to be at risk of tidal flooding. Tidal flood risk does not require further assessment.

Flood risk from artificial water bodies

8.4.33. There are no canals within the study area.

8.4.34. The Environment Agency's reservoir inundation maps indicate that the study area is at risk of flooding from the Dowdeswell reservoir, should the dam fail. This site is located approximately 10 km to the south east of M5 Junction 10, on the eastern side of Cheltenham. This artificial waterbody is regulated by the Reservoirs Act 1975, and as such the risk of breach (dam failure) is very low.

8.4.35. Flooding from artificial waterbodies does not require further assessment.

Flood risk from groundwater

8.4.36. Groundwater flooding of land can occur when groundwater levels rise close to or above ground levels. Groundwater flooding is most likely to occur in low-lying areas underlain by permeable rocks (aquifers).

8.4.37. The BGS susceptibility to groundwater flooding maps show that the Scheme is at high to medium-high risk of groundwater flooding.

8.4.38. At this stage of assessment, based on DMRB LA 113, all flood risk from groundwater receptors within this study area will be classified as having **High to Very High Importance**.

Flood risk from sewers

8.4.39. Sewer flooding occurs when urban drainage networks become overwhelmed with runoff and their maximum capacity is reached. This can also occur if there is a blockage in the network causing water to back up behind it.

8.4.40. Given the predominantly rural nature of the surrounding area, it is unlikely that many of sewerage systems will be crossed by the Scheme.

8.4.41. According to the Cheltenham Borough Council's Strategic Flood Risk Assessment (Halcrow Group Limited, 2008), the study area is considered to have a low level risk of flooding from sewers.

8.4.42. Flooding from sewers does not require further assessment.

8.5. Assumptions and limitations

8.5.1. The assumptions and limitations at the time of reporting are as follows:

- Data quality – only a desk study, using mainly web-based data and previous assessment reports has been undertaken;
- Data quantity – as per quality, only open, freely licensed data has been reported at this stage and therefore the amount of detail on certain topics is limited; and,
- Where impacts are uncertain a precautionary approach has been adopted.

8.5.2. For the next stage the assumptions and limitations are the following:

- Environmental data will be up-to-date and available from accessible sources (mainly web-based);
- Data will be requested from the Environment Agency under the Freedom of Information Act including their survey locations, current strategies and Extended Water Body Summary Sheets;
- Data will be available including traffic and road catchment data to allow water quality modelling assessments to be made;
- Design data in relation to the watercourses will be available to enable hydraulic modelling for flood risk and WFD assessments;
- Access will be acquired to enable site visits to be undertaken;
- Hydraulic modelling to assess the impacts of the Scheme on flood risk requires a verified model, else it will be based upon a number of assumed/estimated parameters, derived from comparable project experience. The work will be limited by the accuracy of the model and thus the observed data supporting it. Assumptions will be made in the absence of observed data;
- Hydraulic modelling analyses will be undertaken in accordance with guidance set out by the Environment Agency and using industry-standard methods; and
- Hydraulic model sensitivity testing will be undertaken to understand the potential impact upon design flood levels caused by variation of model input parameters. On this basis, hydraulic modelling shall be considered to be a suitably robust tool for development planning and informing the preparation of an FRA.

8.6. Potential impacts

8.6.1. It is possible for the Scheme to affect the water environment during construction and operation. An assessment of the impacts will be undertaken using the methodology outlined in DMRB LA 113. At this scoping stage potential impacts for the water environment receptors are outlined below.

Surface Water

8.6.2. Likely significant impacts to surface water receptors during construction of the Scheme could arise from:

- Polluted surface water runoff consisting of high sediment load, chemicals, and hydrocarbons from construction vehicles, plant and high-risk activities that may migrate or be discharged to surface water features;
- Damage to bed, banks and riparian vegetation of watercourses at crossing points due to construction techniques which may deteriorate the ecological and

hydromorphological quality of the watercourse; and,

- Polluted surface water runoff and direct migration of mobile pollutants to groundwater resources from construction vehicles, plant and high-risk activities.

8.6.3. Likely significant impacts to surface water receptors during operation of the Scheme could arise from:

- Increased rates and volumes of surface water runoff resulting from intense rainfall combined with compacted soils and reduced vegetation, which could lead to an increase in flood risk;
- Potential to cause permanent deterioration to the ecological and hydromorphological quality of the watercourse due to alterations to the bed, banks, and riparian vegetation along with the potential loss of open channel and habitat severance;
- Increased rates and volumes of pollution entering the surface water courses during operation as a result of larger impermeable areas and increased traffic volumes; and,
- Increased risk of accidental spillage due to larger traffic volumes during operation leading to higher risk of pollution to surface water courses.

Groundwater

8.6.4. Likely significant impacts to groundwater receptors during both construction and operation of the Scheme could arise from:

- New cuttings, deep foundations and dewatering activities which may cause a temporary barrier to groundwater flow, potentially blocking or altering groundwater flows during construction;
- New cuttings which have the potential to cause a local reduction of groundwater levels, should dewatering be required as part of construction; and,
- Polluted surface water runoff and direct migration of mobile pollutants to groundwater resources from construction vehicles, plant and high-risk activities that may contaminate groundwater resources.

8.6.5. Likely significant impacts to groundwater receptors during operation of the Scheme could arise from:

- New cuttings, deep foundations and dewatering activities which may cause a permanent barrier to groundwater flow, potentially blocking or altering groundwater flows during operation;
- The disposal of pumped water to surface may follow contamination pathways into surface water bodies or infiltrate down into the groundwater body; and,
- Deep foundations and associated sheet piling may have the potential to form rapid vertical flow pathways for pollution into the groundwater bodies and reduce groundwater flow to dependent receptors.

Flood Risk

8.6.6. In accordance with the guidance DMRB LA 113 all projects on motorways and all-purpose trunk roads shall be designed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows; and
- not increase flood risk elsewhere

8.6.7. These requirements limit the potential impacts. However, likely significant impacts to flood risk receptors during construction of the Scheme could arise from:

- Temporary stockpiling of material in the floodplain during construction could result in a loss of flood storage and/or divert existing overland flow routes to areas that

are not currently affected;

- Diversion of runoff, overland flow paths and watercourses during construction can lead to existing small watercourses being inundated, an increase in flood risk to third parties not currently at risk of flooding and increased risk of surface water flooding;
- Excavation adjacent to the banks of watercourses can increase the risk of overtopping and/or breach of the bank;
- Ponds constructed to hold water to manage sediment could cause flooding of local watercourses or adjacent land in the event of overtopping or a breach; and,
- Construction activities that extend below ground have the potential to be affected by groundwater and themselves affect groundwater flooding. Sections of the Scheme are located within areas at high and medium susceptibility to groundwater flooding.

8.6.8. Without the design guidance DMRB LA 113, significant impacts to flood risk receptors during operation of the Scheme could arise from:

- Earthworks and associated structures could generate a loss of floodplain. Without appropriate mitigation, the Scheme could result in loss of flood storage and increase flood risk;
- Blockages within watercourses and/or the floodplains, ultimately reducing their floodwater conveyance capacity and attenuation capability;
- Permanent earthworks could sever or block overland flow paths leading to ponding of rainfall;
- Realignment of existing watercourses and change of existing structures, has the potential to increase fluvial flood risk; and,
- An increase in the paved (impervious) area will generate more runoff and increase the volume of flood water.

8.7. Potential mitigation measures

8.7.1. In line with DMRB LA 104, significant effects will be those that typically comprise of any residual impacts that are within the moderate, large or very large categories. Should these be identified then additional mitigation measures would be implemented.

8.7.2. Any proposed mitigation measures would be in addition to the embedded mitigation within the project's design. Mitigation measures for the water environment receptors are outlined below.

8.7.3. During construction, potential mitigation measures will be captured within a Construction Environment Management Plan (CEMP). Many of these measures are likely to be associated with good site practice and the preparation of robust method statements (e.g. Pollution Prevention and Incident Control Plan Pollution Prevention Guidelines (PPGs)) (Environment Agency, 2013). Although PPGs have been archived, they are still relevant and considered good practice.

Surface Water

8.7.4. Mitigation measures for operational impacts with moderate to very large adverse impacts to surface water features could include, but are not limited to:

- Implementation of Sustainable urban Drainage Systems (SuDS) to mitigate the pollution risk associated with road runoff;
- Where culverts are required, continuity of natural bed substrate through the structures should be retained. Sediment retention mechanisms may be required in the form of baffles to ensure sediment is maintained within steep culverts. Energy dissipation measures may be required depending on the culvert gradients; these may include stilling basins. The culvert lengths should be kept to a minimum and sized to facilitate any environmental needs (e.g. fish passage);

- Where bed or bank protection are proposed 'softer' bioengineered solutions should be prioritised to provide a cheaper, more sustainable design where possible;
- The role of vegetation and riparian planting should also be considered to provide long-term bank stability and additional habitat;
- Where river realignments are proposed, the designs should replicate the natural character of the watercourse and be considered appropriate improvements to the hydromorphological and biological quality of the watercourse; and,

8.7.5. Mitigation measures will be proposed based on best practice guidance as well as the outcome of the WFD assessment, consultation with the Environment Agency and through discussions with the specialists carrying out the biodiversity assessment.

Groundwater

8.7.6. Mitigation measures for operational impacts to groundwater receptors are similar to those for surface water, and include, but are not necessarily limited to:

- Groundwater site specific intrusive ground investigation must be undertaken to obtain appropriate groundwater level and quality monitoring in the vicinity of the works to feed into the design of any deep foundations extending beneath the groundwater table;
- Where deep foundations extending beneath the groundwater table are designed to be part of the option, these should be designed in accordance with industry standards, including Piling Risk Assessment if required - taking into account the site specific water level and flow monitoring data obtained from intrusive ground investigation for the option;
- Any dewatering activities should be compliant with industry standards and best practice; and,
- Implementation of SuDS to mitigate the pollution risk associated with road runoff.

Flood Risk

8.7.7. A drainage strategy will be developed to address the management of runoff to ensure flood risk to the surrounding area is not increased. A flood risk assessment will be undertaken to quantify the flood risk to and from the Scheme. Where appropriate, opportunities to enhance beneficial effects will also be identified.

- Development of a Flood Management Plan to ensure that the proposed construction site can be safely operated and will not be affected in the event of a flood, and that floodplain working can be minimised as far as possible;
- Allocation of construction land set aside for robust flood control measures, for example SuDS;
- Implementation of appropriate sediment management from the construction site to reduce risk of blockage in existing structures downstream of temporary outfalls;
- Construction and location of any ponds for runoff and sediment management to avoid the risk of flooding watercourses or adjacent land in the event of overtopping or a breach; and,
- Implementation of temporary flood compensation areas in advance of any earthworks that result in the loss of floodplain.
- Use of large conveyance structures for new and replacement crossings of the watercourses and floodplains.
- Inclusion of compensatory floodplain using replacement floodplain or washlands; and
- Implementation of a drainage strategy to manage the surface water runoff that includes SuDS designs that consider the lifetime of the development taking account of climate change and make provision for the adoption and maintenance, including any necessary access rights.

8.8. Likely residual effects

8.8.1. An assessment of residual effects (after mitigation) will be presented at the next stage. It is assumed that good practice mitigation measures will be incorporated into the design, therefore, the magnitude of impact of the Scheme is anticipated to be at worst of minor adverse for all impacts on the basis that the design will minimise the impact, and embedded mitigation will further reduce the impacts to a negligible level.

8.8.2. Subject to the implementation of all mitigation measures, as set out in the principles and purpose of environmental assessment DMRB LA 104, the overall residual significance of effect on all water receptors **during construction** is anticipated to be neutral.

8.8.3. The likely residual effects **during operation** are outlined below for the water environment receptors, as far as can be anticipated before more detailed assessment is undertaken.

Surface water

8.8.4. The Scheme has the potential to impact watercourses of very high or high importance based on the DMRB LA113. With an anticipated negligible magnitude of impact, there would be a **slight adverse** significance of effects from the Scheme.

Groundwater

8.8.5. The Scheme overlays groundwater receptors of medium importance based on the DMRB LA113. With appropriate mitigation in place anticipated to reduce the impacts to a negligible level, there is likely to be a **neutral to slight adverse** significance of effect from the Scheme.

Flood risk

8.8.6. The Scheme has the potential to impact flood risk receptors of high or very high importance. With all mitigation in place, the magnitude of impact is expected to be no more than negligible resulting in the overall residual significance of **slight adverse** effect during operation.

8.9. Proposed level and scope of assessment

8.9.1. Based on the level of data at the time of reporting (of both baseline and proposed works for the Scheme), the water receptors scoped into further assessment are detailed below in Table 8-4, along with an overview of what that assessment should entail.

Table 8-4 - Receptors and scoping decision and level of assessment

Receptor/s	Scoped in/out	Comment/Justification
Surface water	In	The extent of impact will need to be assessed quantitatively using a simple assessment and HEWRAT to recommend the appropriate level of mitigation. Based on the outcomes of this scoping report, a WFD compliance assessment is required to demonstrate that proposals will not result in a deterioration in status (or potential) of any water body or prevent the water body from meeting good status (or potential) in the future . Compliance with the Directive can only be fully demonstrated once detailed designs of the Scheme have been prepared. However, design is an evolutionary process, and the earlier within that process the WFD can be considered, the more readily the legal requirements of the directive can be integrated into the design to ensure likelihood of compliance.

Receptor/s	Scoped in/out	Comment/Justification
Groundwater	In	The Scheme is underlain by Secondary Aquifers. Therefore, a groundwater assessment is required to consider likely effects of the Scheme. Two WFD groundwater bodies also underlay the Scheme and therefore groundwater will need to be considered as part of the WFD compliance assessment.
Flood Risk (fluvial, surface water, and groundwater flooding)	In	The study area is at high risk of fluvial flooding and the Scheme could cause significant adverse effects without mitigation. Surface water flooding also has the potential to impact residential properties. A detailed assessment of flood risk will be required and the provision of floodplain compensation likely. Similarly, an assessment of risk from groundwater flooding will be required. The analyses will form the basis of a detailed FRA supporting the ES and design.
Flood Risk (tidal, and sewer flooding, flooding from artificial sources)	Out	With no canals and a single regulated reservoir, flood risk from artificial water bodies is scoped out of further assessment. It is unlikely that the Scheme will require a connection into the existing sewerage network: the Scheme will be developed with its own drainage systems. With low risk, flood risk from sewers has been scoped out from further assessment. The Scheme will not give rise to significant effects on these flood risk receptors.

8.10. Proposed assessment methodology

8.10.1. The methodology guidance presented in DMRB LA113 will be applied to assign both the importance of the receptors and the magnitude of impact of the Scheme. The significance of the potential impact shall be determined in accordance with DMRB LA104. This guidance will also be used at the next stage of the environmental assessment.

8.10.2. Desk based studies will be conducted using a range of open source data. Data request to the Environment Agency will be necessary to gather the following information (but not limited to):

- WFD Extended Water Body Summary Reports;
- Ecological data;
- Abstraction and discharge locations; and
- Mitigation strategies in place.

8.10.3. A FRA will be produced in accordance with the requirements of the NN NPS (Department for Transport, 2014), the NPPF (Department for Communities and Local Government, 2018) and its accompanying Technical Guidance (Department for Communities and Local Government, 2014) and the Environment Agency's climate change allowances (Environment Agency, 2020d).

8.10.4. A WFD compliance assessment will be completed to ensure the Scheme and embedded mitigation is compliant with WFD guidelines. In addition to the LA113 guidance, the WFD assessment will also follow guidance presented in LA108. The WFD compliance assessment will require site walkover surveys to be undertaken following Advice Note 18, The Planning Inspectorate (The Planning Inspectorate, 2017).

8.11. Proposed consultation

8.11.1. Consultation with Gloucestershire County Council and the Environment Agency and other relevant authorities will be undertaken to inform the ES, WFD compliance assessment and FRA.

8.12. Conclusion

8.12.1. In line with the DMRB an assessment will be required where there is a potential for any road project to adversely affect the water environment. This scoping report has identified that the Scheme has the potential (if left unmitigated) to significantly impact the water environment, therefore, further assessment is warranted. The assessment will use appropriate methodologies to assess the likely effects upon the water environment whilst also proposing appropriate mitigation measures that are proportionate to the significance of impacts.

8.12.2. Road drainage and the water environment is scoped into the next stage of assessment and the topics, determined as above (Table 8-4), should include Surface Water, Groundwater and Flood Risk. In addition, a standalone FRA and WFD compliance assessment will be undertaken.

8.12.3. Sections scoped out of further assessment include: flood risk (tidal and sewer flooding and flooding from artificial sources).

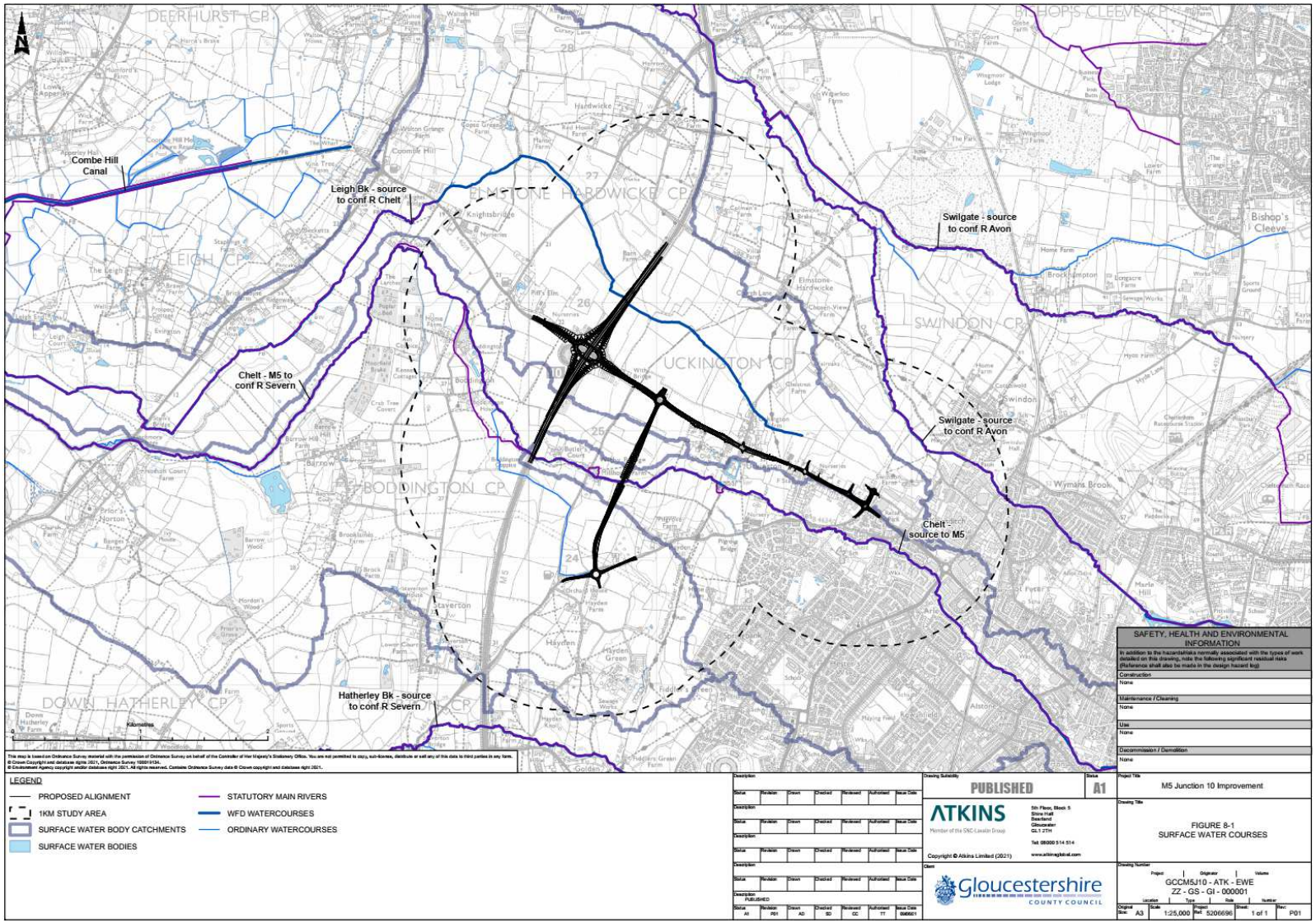

Figure 8-1 - Location of the Scheme in relation to the surface water bodies

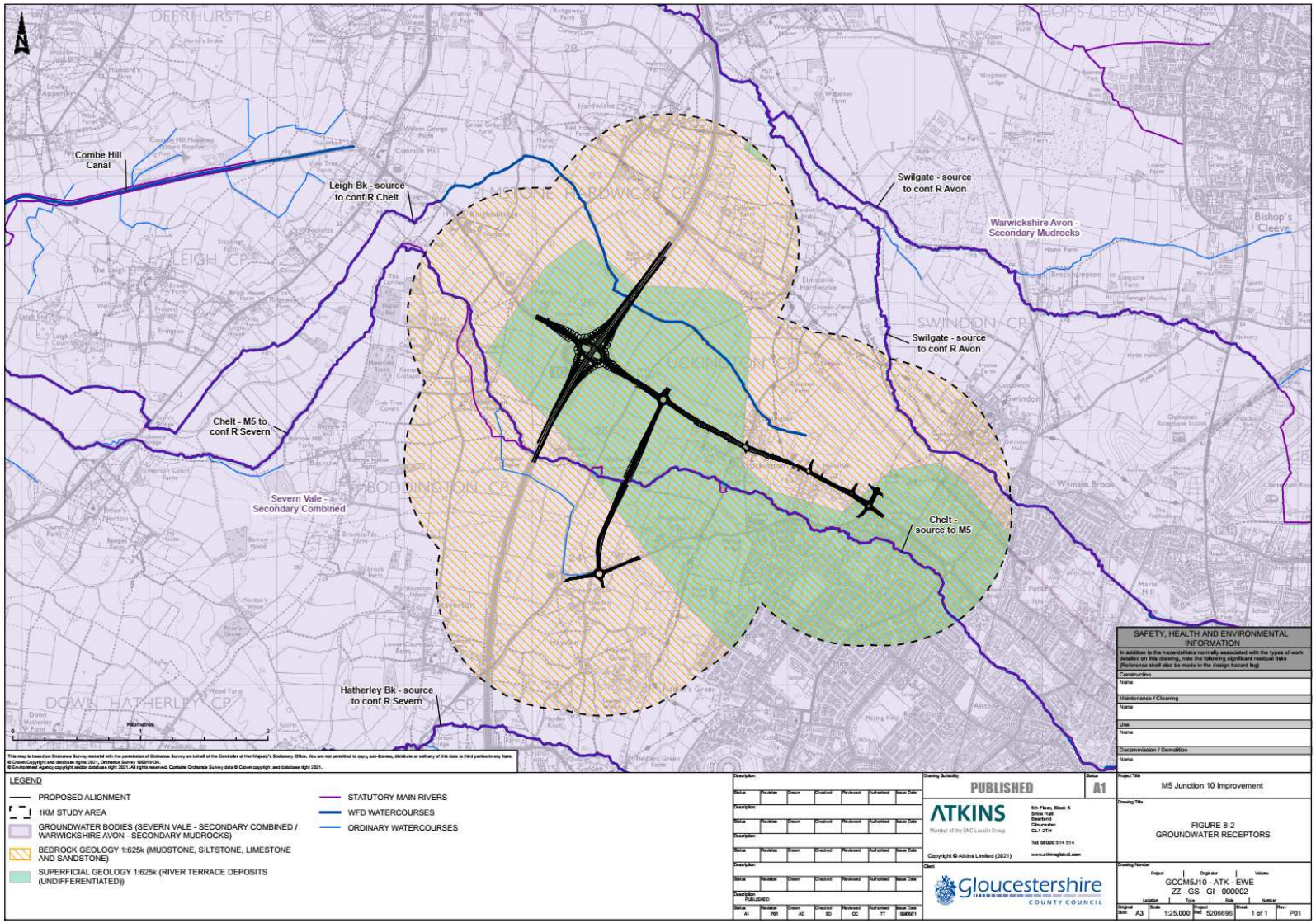

Figure 8-2 - Location of the Scheme in relation to groundwater receptors

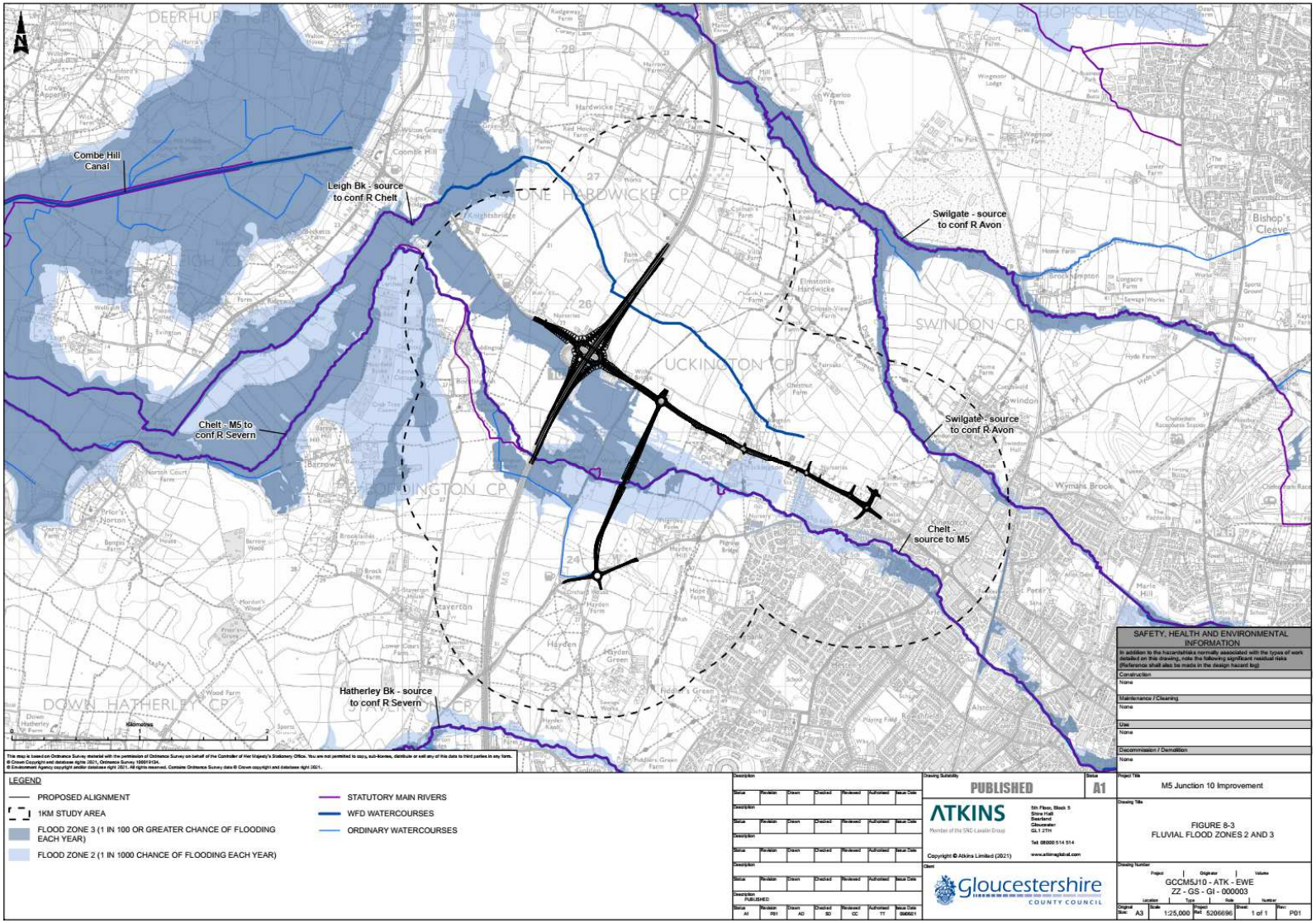

Figure 8-3 - Flooding from flood zones 2+3

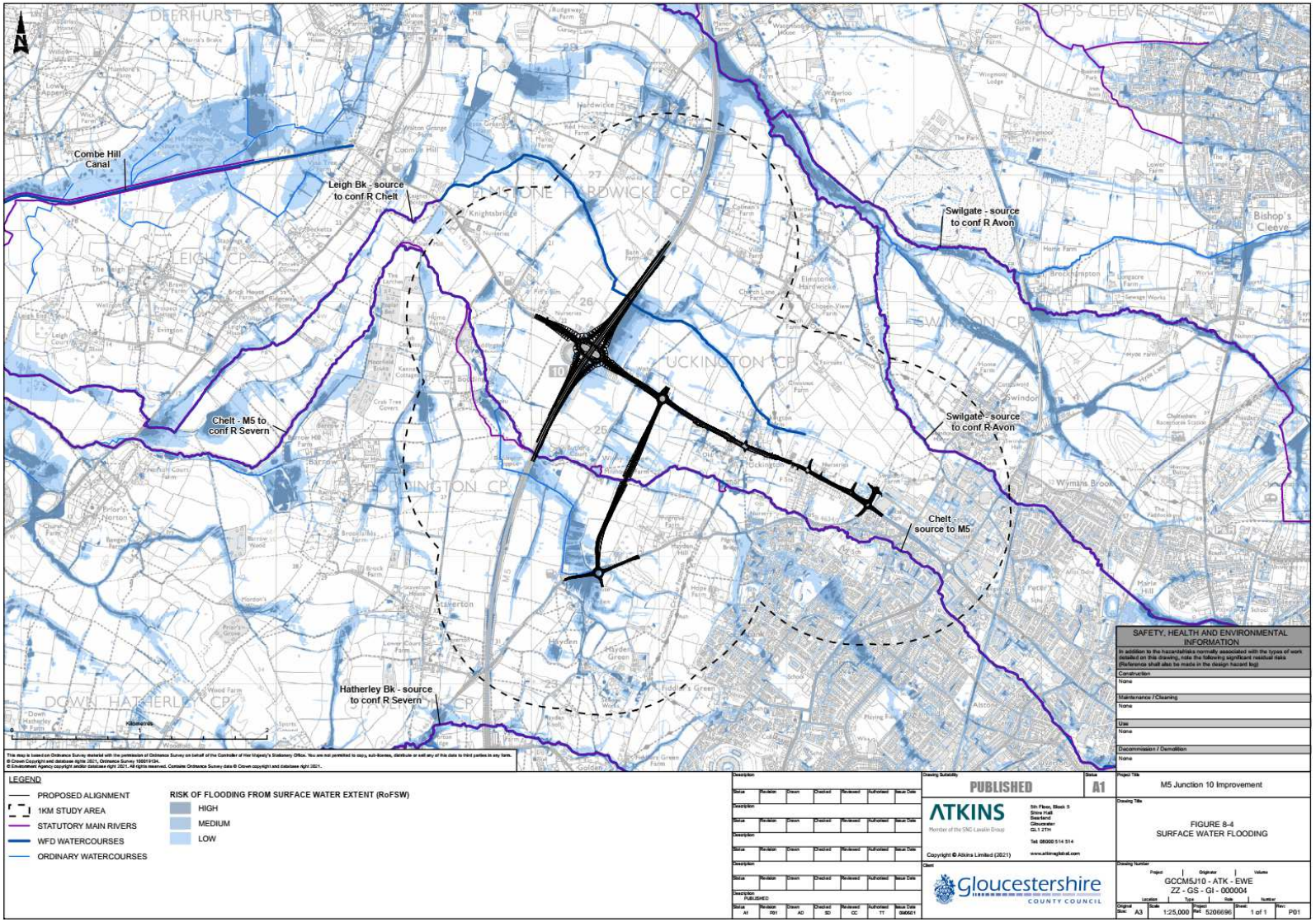

Figure 8-4 - Flooding from surface water.

9. Landscape and Visual

9.1. Introduction

9.1.1. The chapter presents the proposed scope and methodology for the Landscape and Visual Impact Assessment (LVIA) chapter of the ES for the Scheme. It includes a review of the baseline landscape and visual conditions to inform the scope.

9.1.2. The purpose of the LVIA will be to identify potentially significant landscape and visual effects that are predicted to arise from the construction and operation of the Scheme. Landscape effects derive from changes in the physical landscape which may give rise to changes in its important characteristics and thus its character, and how this is experienced. Visual effects relate to the changes that arise in the composition of available views as a result of changes to the landscape, to people's responses to the changes, and to the overall effects with respect to visual amenity.

9.1.3. The assessment will be undertaken in accordance with current best practice guidelines as set out within:

- Sustainability & Environmental Appraisal, LA 107 Landscape and Visual Effects, DMRB, Revision 2 - Feb 2020 (formerly DMRB Volume 11 Section 3 Part 5 Landscape Effects and IAN 135/10);
- Guidelines for Landscape and Visual Impact Assessment Third Edition (2013) (GLVIA3), published by the Landscape Institute and the Institute of Environmental Management & Assessment;
- GLVIA3 Statement of Clarification 1/13 (2013), published by the Landscape Institute;
- Landscape Institute Advice Note 01/11, Photography and Photomontage in Landscape and Visual Impact Assessment (2011), published by the Landscape Institute; and
- An Approach to Landscape Character Assessment (2014), Christine Tudor, published by Natural England.

9.1.4. GLVIA emphasises the distinction between landscape effects and visual effects and the Landscape Character and Visual Amenity chapter of the ES will deal with and clearly distinguish between the assessment of landscape effects, dealing with changes to the landscape as a resource, and the assessment of visual effects, dealing with changes in views and visual amenity.

9.1.5. Both DMRB LA107 and GLVIA3 require a ‘proportionate’ approach to assessment, with factors unlikely to give rise to significant effects being scoped out. The study area and identifed receptors reflect this approach.

9.2. Study area

Landscape Study Area

9.2.1. The desk top study and site visit undertaken during PCF Stage 2 informed the extent of the study area for both the landscape and visual effects.

9.2.2. It is expected that potentially significant landscape effects would be restricted to the land directly adjacent to the Scheme, however consideration of landscape effects will be given to the wider area. Given the type of scheme and existing context it is considered that a study area of 1 km from the perimeter of the Scheme would be proportionate. Any effects upon landscape receptors located outside this study area are highly unlikely to be significant and have been scoped out from further assessment.

9.2.3. Should the Scheme substantially change during the assessment stage, the extent of the study area will be reviewed to ensure it remains appropriate to the assessment.

Visual Study Area

9.2.4. When considering the type of scheme and in the context of the relatively flat topography and natural and manmade screening elements present within the area, it is considered that a study area of 1 km from the edge of the Scheme would also be sufficient to identify potentially significant visual effects. Any effects on visual receptors beyond the study area are highly unlikely to be significant and have generally been scoped out from further assessment. However, as a precautionary approach it is considered prudent to examine potential visual receptors in certain locations outside of the 1 km study area. These include PRoW and open access land within the Cotswolds AONB set on higher ground, where long distance views of the Scheme may be possible.

9.2.5. The study area may be refined through a combination of computer-generated Zone of Theoretical Visibility (ZTV), field work and consultation with statutory stakeholders. This will inform the final selection of viewpoints for the assessment, which will also be agreed with the relevant stakeholders.

9.2.6. Should the Scheme substantially change during assessment stage, the extent of the study area will be reviewed to ensure it remains appropriate and proportionate to the Scheme.

9.3. Planning policy and topic legislative context

National policy

National Policy Statement for National Networks (NN NPS, 2014)

9.3.1. The Scheme falls within the definition of an NSIP, making the NN NPS the primary planning policy against which an application for a DCO for the Scheme would be judged.

9.3.2. Paragraphs 5.143 - 5.161 relate to landscape and visual impacts, including how these impacts influence the decision-making process in highways developments for NSIPs, for which development consent is sought under the Planning Act 2008.

9.3.3. Paragraph 5.144 states that 'where the development is subject to EIA the applicant should undertake an assessment of any likely significant landscape and visual impacts in the environmental impact assessment and describe these in the environmental assessment'. This should include reference to any landscape character assessment and any relevant policies based on these assessments in local development documents in England.

9.3.4. NN NPS states that the assessment should include visibility and conspicuousness of the project during construction and of the presence and operation of the project and potential impacts on views and visual amenity. This should include any noise and light pollution effects, including on local amenity, tranquillity and nature conservation.

9.3.5. Paragraph 5.151 states that the Secretary of State should refuse development consent for NSIPs in nationally designated areas such as Areas of Outstanding Natural Beauty (AONB) and National Parks, except in exceptional circumstances and where it can be demonstrated that it is in the public interest. Furthermore, paragraph 5.156 outlines that local landscape designations should not be used in themselves as reasons to refuse consent, as this may unduly restrict acceptable development. However, developments should be carefully designed and seek to avoid or minimise harm to the landscape.

9.3.6. Furthermore, the criteria for 'good design' for national network infrastructure, in Paragraph 4.29, outlines the requirement that *'visual appearance should be a key factor in considering the design of new infrastructure, as well as functionality, fitness for purpose, sustainability and cost. Applying 'good design' to national network projects should therefore produce sustainable infrastructure sensitive to place, efficient in the use of natural resources and energy used in their construction, matched by an appearance that demonstrates good aesthetics as far as possible.*'

9.3.7. Paragraphs 5.162 - 5.185 relate to 'land use including open space, green infrastructure and Green Belt'. Paragraph 5.178 notes the presumption against inappropriate development within the Green Belt and the need for very special circumstances demonstrating that any potential harm is outweighed by other considerations. Paragraphs

5.179 - 5.180 also note that "*Applicants can minimise the direct effects of a project on the existing use of the proposed site, or proposed uses near the site by the application of good design principles, including the layout of the project and the protection of soils during construction… ensure…the functionality and connectivity of the green infrastructure network is maintained and any necessary works are undertaken, where possible, to mitigate any adverse impact and, where appropriate, to improve that network and other areas of open space, including appropriate access to…National Trails and other public rights of way."*

National Planning Policy Framework (NPPF, 2019)

9.3.8. Given that the Scheme is an NSIP, the NPPF has the status of a material consideration in planning terms.

9.3.9. Paragraph 127 asserts that policies and decisions should ensure that developments 'are sympathetic to local character and history, including the surrounding built environment and landscape setting, while not preventing or discouraging appropriate innovation or change.'

9.3.10. Paragraph 170 states that the planning system should contribute to and enhance the natural and local environment by protecting and enhancing valued landscapes. As with biodiversity, protection should be commensurate with their status.

9.3.11. Paragraph 180 states that policies and decisions should ensure that new development is appropriate for its location, taking into account 'the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.'

Regional policy

Gloucestershire Local Transport Plan 2020-2041

9.3.12. LTP PD 4.3 - Highway Maintenance offers important guidance on design of developments in relation to the landscape setting, stating that GCC will manage the local highway asset in line with the Transport Asset Management Plan (TAMP), the Highways Maintenance Handbook and other guidance or policies in order to *'minimise the impact of highway work on the surrounding landscape and ensure where new highway structures are required they need to be sympathetic to their surroundings.*'

Local policy

Gloucester, Cheltenham and Tewkesbury Joint Core Strategy 2011-2031

9.3.13. Policy SD4: Design Requirements outlines several key factors that developments must adhere to. Regarding public realm and landscape, the policy states that *'new development should ensure that the design of landscaped areas, open space and public realm are of high quality, provide a clear structure and constitute an integral and cohesive element within the design.*'

9.3.14. Policy SD6: Landscape builds on Policy SD4 and provides further detailed landscape requirements to consider. In particular, 'development will seek to protect landscape character for its own intrinsic beauty and for its benefit to economic, environmental and social well-being', as well as having regard 'to the local distinctiveness and historic character of the different landscapes in the JCS area'. All developments will be required to 'demonstrate how the development will protect or enhance landscape character and avoid detrimental effects on types, patterns and features which make a significant contribution to the character, history and setting of a settlement or area.'

9.3.15. Policy INF3: Green Infrastructure is important as it places weight on the relevance of the green infrastructure network to landscape character, stating that *'development proposals should consider and contribute positively towards green infrastructure, including the wider landscape context and strategic corridors between major assets and populations.*'

Cheltenham Borough Council Local Plan - Saved Policies (2006)

9.3.16. Policy CP 3: Sustainable Environment states that development will be permitted only where it would *'not harm landscape character*.' Furthermore, Policy CP 7: Design states that development will only be permitted where it *'complements and respects neighbouring development and the character of the locality and/or landscape*.'

Landscaping in New Development Supplementary Planning Guidance (2004)

9.3.17. The overarching objective of this SPD, produced by CBC, is to set out a framework to ensure that the design, implementation and aftercare of landscaped areas in Cheltenham achieve a high standard. As such, considerable importance is placed on achieving high quality landscaped areas.

9.3.18. Paragraph 4.1 sets out that CBC will expect developers to be responsible for the design, specification, and layout of landscaped areas as part of the overall development of a site.

9.4. Baseline conditions

Landscape Character

National

9.4.1. The study area is located within National Character Area (NCA) No.106 – Severn and Avon Vales. It is considered that whilst NCA's provide a level of information to help inform the context of local character assessments, they do not provide a sufficient level of detail appropriate to the nature of the effects likely to arise as a result of the Scheme. As such the NCA will be included within the baseline studies as part of a hierarchical review of landscape character but will not be considered within the assessment. The assessment will focus on the more pertinent local landscape character assessments which cover the study area. These are described below.

County

9.4.2. The landscape character of Gloucestershire is described within the Gloucestershire Landscape Character Assessment undertaken by LDA in 2006, covering the Severn Vale, upper Thames Valley, Vale of Moreton and Vale of Evesham Fringe.

9.4.3. The Scheme is wholly located in the Landscape Character Type (LCT) 'Settled Unwooded Vale'. The key characteristics of this LCT are:

- soft, gently undulating to flat landscape, but with intermittent locally elevated areas that project above the otherwise flatter landform;
- major transport corridors pass through the Vale, frequently aligned north south, beyond which is a network of local roads and lanes linking villages and hamlets;
- limited woodland cover with mature hedgerow trees;
- area drained by a series of east west aligned tributaries of the Severn, including the Chelt;
- mixed arable and pastoral land use enclosed by hedgerow network, in places forming a strong landscape pattern;
- Rural areas bordered by large urban and suburban areas and interspersed with commercial and industrial premises; and
- Widespread network of pylons and transmission lines.

Local

9.4.4. As defined by the Gloucestershire Landscape Character Assessment, the Scheme lies wholly within the SV6B: Landscape Character Area (LCA) 'Vale of Gloucester'. The key characteristics of this LCA are:

- to the east, the Vale is defined by the rising landform of the Cotswolds escarpment

and Oxenton Hill. To the west of the Vale lies the Floodplain Farmland landscape character type;

- the intermittent small ridges, hillocks and undulations that rise above the general level of the Vale are important local features;
- undulating landform encloses views in some areas whilst in other areas there are distant views beyond the vale landscape towards the Cotswolds Escarpment and the Escarpment Outliers;
- woodland is not a characteristic feature of the Vale of Gloucester and is generally limited to few small copses;
- the M5 forms a spine through the heart of the Vale and, although often screened by adjacent embankments and vegetation, there are frequent filtered views towards the motorway from the surrounding Vale landscape and the noise generated by motorway traffic is readily audible;
- there is a widespread network of pylons and transmission lines; and
- large watercourses including Hyde Brook, River Swilgate, River Chelt and Hatherley Brook generally flow east-west across this landscape before heading south to join the River Severn.

Local Landscape Features

9.4.5. The landscape within the study area is typical of the character described within the published landscape character assessments, being a gently undulating Vale landscape featuring a mixture of arable and pastoral fields. Arable fields tend to be more frequent in the west of the study area adjacent the M5 corridor and larger in size than those of pasture. Smaller pastoral fields are often located adjacent the urban edges of Cheltenham in the east near Uckington, Swindon Village and Springbank, some being horse paddocks associated with the settlements.

9.4.6. The land rises up in the east and north east beyond the study area creating the Cotswolds escarpment and outliners, such as Cleeve Hill and Oxenton Hill which form part of the Cotswold AONB. These are prominent features on the skyline, often visible from the low lying open areas, although over 6 km away.

9.4.7. Flat low-lying floodplain farmland exists to the west of the study area, where tributaries to the River Severn form a network of smaller rivers, streams, brooks and ditches. Views across this floodplain landscape are notable from the slightly higher ground in the far west of the study area at Coombe Hill, where a ridge line exists which the A38 follows, running parallel with the River Severn.

9.4.8. The M5 forms a major feature through the landscape, although this major transport corridor is often well screened in places by vegetation aligning the route. The carriageway for the section within the study area is slightly raised above the surrounding flat landscape, with small vegetated embankments to either side. These embankments are at times heavily planted with tall trees and shrubs, while intermittently these break up into patchy scrub and individual trees. At these locations' views are possible across the surrounding vale landscape. Overbridges and the existing raised Junction 10 tend to be well screened by vegetation. The M5 is unlit along this section within the study area.

9.4.9. The A4019 at the junction with the M5 is raised up quite high above the surrounding landscape and although there's substantial vegetation to provide screening, views to the west are possible. As the road runs east away from the junction, it falls down to the level of the surrounding landscape by the time it reaches the junction with Withybridge Lane. The majority of the highway is bordered by low field hedgerows, allowing open views across the landscape. To the east of Ukington the road becomes more enclosed by residential and community properties, and associated perimeter vegetation, becoming urban in character with retail and business parks appearing on the approach to the junction with the B4634. To the west of Uckington the carriageway is unlit but to the east side it is lit on the approach to the outskirts of Cheltenham.

9.4.10. The River Chelt passes centrally through the study area, meandering east to west through floodplain farmland. It runs from Kingsditch, then to the south of Uckington, through Withy Bridge before crossing under the M5 to reach Boddington and Barrow in the west.

9.4.11. High voltage pylons march in pairs across the southern section of this floodplain from Springbank in the east, heading west past Hayden, crossing the M5 west towards Prior's Norton. Further pylons branch off these, running north parallel with the M5, passing Boddington and heading off past Hardwicke. These pylons make a prominent feature along the skyline in the study area.

9.4.12. Settlements tend to be small clusters of properties generally focused on a farm, village hall or church, which are often well screened by property vegetation, although properties along the A4019 generally have more open views.

Landscape Designations

9.4.13. The Cotswolds AONB is nationally designated area of importance, recognised for its distinctive landscape with wide open views, dry stone walls, intimate valleys, flower rich grasslands, ancient woodlands, dark skies, tranquillity, archaeology, historic and cultural heritage and distinctive Cotswold stone architecture.

9.4.14. The AONB is located 4.5 km from the eastern extent of the of works on A4019 and over 6 km from the M5 Junction 10. Although this is quite some distance, it is important to consider any visibility from the AONB of the Scheme that may detrimentally impact upon its unique and attractive qualities.

9.4.15. The AONB includes the higher ground east of Cheltenham such as Cleeve Hill which does have views toward the Scheme study area, such as from Cleeve Common where there is limited immediate vegetation cover.

Visual Amenity

9.4.16. Visual receptors are the people who live in or visit the landscape, and who will experience views of the Scheme. Residents and users of accessible land and rights of ways used for the enjoyment of the countryside are considered higher sensitivity visual receptors. Users of roads or those undertaking occupational work, are considered lower sensitivity visual receptors. The receptors will be identified by desktop study using Zone of Theoretical Visibility (ZTV) modelling and will be verified through site visits. Viewpoints will be selected to represent the visual receptors likely to experience effects, these will be agreed in consultation with environmental stakeholders.

9.4.17. A brief description of likely visual receptors for the Scheme are noted below and indicated on Figure 9-1. A full descrition of receptors considered in this scoping report are providded in Section 9.9 which sets out which receptors will or will not be assessed within the EIA.

Public Rights of Way

9.4.18. The study area contains several footpaths and bridleways, including the Long-Distance Footpath of Cheltenham Circular.

9.4.19. The PRoW are generally within fields often running along hedged boundaries or the side of streams or rivers, occasionally crossing open areas within the fields. Short range views are likely to be to be limited by intervening hedge boundaries, buildings and the flat topography. Longer ranging views are possible of the raised land beyond the study area which includes the Cotswold escarpment and outliers. Views towards the Scheme from these raised landforms, such as the open access land and PRoWs within the Cotswolds AONB, are possible but over very long distances.

Properties

9.4.20. There are quite distinct clusters of properties dotted within the study area, usually forming parts of the local villages and settlements.

9.4.21. Many residential properties are also surrounded by outbuildings. Garden, boundary and roadside vegetation often aid screening.

9.4.22. Views vary; sometimes enclosed by property vegetation, sometimes open across quite a rural landscape, occasionally punctuated with detracting views of pylons or road infrastructure and, particularly toward the eastern end of the A4019, over a more urbanised landscape.

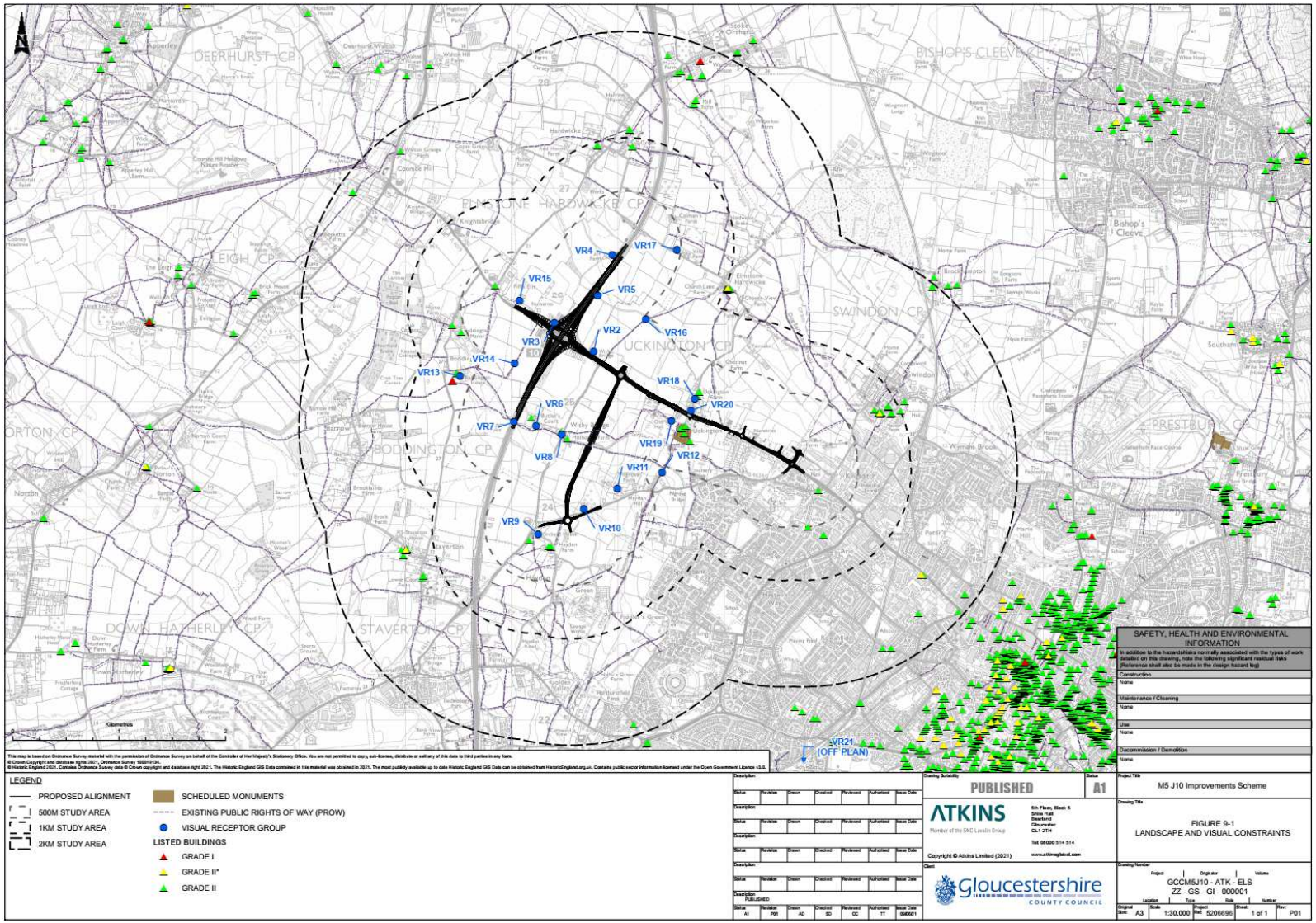

Figure 9-1 - Landscape and visual constraints

9.5. Assumptions and limitations

9.5.1. The LVIA will be based on, and limited to, the baseline conditions observed at the time of the site surveys and additional desktop information. Surveys will cover the summer and winter but will not include other seasons.

9.5.2. Landscape is formed by the interplay between the natural, physical and cultural components of the environment and as such the assessment of landscape and visual effects is a process closely linked with other topics, notably ecology and the historic environment. The LVIA will consider the contribution heritage and ecological features make to the character and value of the landscape and visual receptors, along with an assessment of the likely effect of the Scheme on the landscape character and views associated with heritage features. The LVIA will be carried out in landscape and visual terms only, as an assessment of effects on heritage assets and their wider cultural setting (e.g. impacts on cultural and historic associations) are considered to be beyond the remit of LVIA and will be covered in other chapters. The LVIA will not assess direct or any other indirect effects on heritage or ecological resources.

9.5.3. The LVIA will be based on views from publicly accessible locations. Where an impact on residential and other private views (e.g. commercial properties) is noted, this will necessarily be estimated (unless access is provided by a landowner). The viewpoints that will be identified in the LVIA are illustrative of the worst-case potential impact from a representative range of receptors including residences, rights of way, public open spaces, private open space, commercial operations, the road and rail network etc. The LVIA will not necessarily identify all locations from where the proposed development would potentially be visible.

9.6. Potential impacts

Construction

9.6.1. During Construction, the general aspects of the Scheme that are likely to cause impacts through changes to the landscape or appearance of the road infrastructure are:

- the introduction of temporary construction compound, storage areas and haul routes, temporary lighting and traffic management, presence of construction machinery including cranes and increased vehicular movement;
- vegetation removal to verges and Scheme footprint;
- introduction of embankments /false cuttings;
- demolition of buildings and structures;
- construction of new motorway junction, new link roads and roundabouts;
- widening of A4019;
- diversion of PRoWs; and
- inclusion of attenuation ponds as new features within the landscape.

Operation

9.6.2. During Operation, the general aspects of the Scheme that are likely to cause impacts through changes to the landscape or appearance of the road infrastructure are:

- increased visual prominence of infrastructure features including bridges, new roads, roundabouts and associated earthworks, particularly in the early years of operation as planting is maturing;
- new crossing features on existing PRoW, or permanently diverted PRoW routes;
- presence of new drainage features visible in the landscape, such as attenuation ponds;
- permanent encroachment of road/pavement into previously undeveloped land;

- new gantries and signage, lighting and other road safety features; and
- introduction of environmental design measures including new areas of planting and seeding to help the integration of the Scheme into the landscape.

9.7. Potential effects and mitigation measures

9.7.1. Vegetation removal and construction activities are likely to cause adverse effects on the landscape character. Effects on regional or national character are considered unlikely to be significant, however, on a more local scale the effect may be significant; such as around Sheldon nurseries and adjacent properties. Mitigation measures for the vegetation loss and character change cannot easily be mitigated in the short term, although advance mitigation planting could be considered. Standard mitigation measures for construction activities would be implemented with any project specific measures proposed following assessment.

9.7.2. Upon completion, the loss of vegetation would also initially be an adverse impact, however, advanced mitigation planting would aid the reduction of adverse effects more quickly. Care would need to be taken in providing appropriate vegetation screening to mitigate visual impacts, whilst not creating blocks of woodland that are not typical of the character of the area.

9.7.3. Although there would be increased presence of roads and associated infrastructure, these would essentially be in keeping with the existing landscape character of the area, which does include roads aligned north/south as characteristic aspects. Similarly, adjustments to the M5 Junction itself would not be out of place in the existing landscape character context. The effect of the viaduct for the link road needs further consideration once more detail is available.

9.7.4. The Scheme would include attenuation ponds. Although there are ponds within the study area, they are typically not of the scale suggested by the indicative design. It is anticipated that design development would include exploring “naturalistic” formations, utilising underground storage features and introducing well-considered landscaping, which would help to integrate the ponds and mitigate any significant adverse effect on the character of the landscape due to the introduction of incongruent and potentially intrusive features.

9.7.5. The presence of Tree Protection Orders or Ancient and Veteran Trees is currently being reviewed. Any impact on these resources would be assessed as part of the full EIA should any be located within the study area.

9.7.6. Where views are possible the potential effects of the Scheme generally depend upon proximity and existing retained screening, and the sensitivity of visual receptors to a change to their view. In some cases demolition of properties is required and several PRoW are directly affected by the Scheme.

9.7.7. Potential effects are expected to range from negligible to major without mitigation.

9.7.8. Detailed mitigation measures would be worked up as part of the overall preferred route design to ensure significant effects are avoided.

9.7.9. Vegetation removal should be kept to that necessary for the works and where possible new road alignments should be adjusted during design development to avoid mature trees and hedgerows.

9.7.10. Good quality junction, road, viaduct and associated infrastructure is essential to embed these features into the landscape and ensure they do not dominate any view or appear out of place.

9.7.11. Well considered mitigation planting is important to provide adequate screening in appropriately sized banks of planting and avoid the introduction of uncharacteristic large blocks of woodland.

9.7.12. Enhancement of the environment along the A4019 to improve the experience for residents, pedestrians, cyclists and vehicles users.

9.8. Likely residual effects

9.8.1. In the long term, assuming a well considered design and following establishment of mitigation and enhancement planting is is considered likely that residual effects would not be significant.

9.9. Proposed level and scope of assessment

9.9.1. Significant effects associated with landscape and visual impacts of the Scheme are anticipated in the absence of mitigation. As a result, further studies are required to assess the significance of effects on landscape and visual receptors. Further detailed desk and fieldwork studies will be undertaken to identify the character of the landscape, including its condition and value, and the nature and sensitivity of the visual receptors that may be affected by the Scheme. The assessment of landscape and visual effects will propose and take account of suggested mitigation/environmental design measures to avoid, reduce or remedy the effects of the Scheme options.

9.9.2. The ZTV will help identify representative viewpoint locations which will be visited, verified and form the basis of the assessment of effects on visual amenity within the LVIA. The LVIA will also assess changes in visual amenity as a result of effects arising from any additional land areas associated with the Scheme.

9.9.3. The viewpoints will be drawn from publicly accessible locations chosen to cover the range of effects on visual amenity from receptors such as residential areas, PRoW, highways, commercial and leisure locations, although not all categories may be present. The viewpoints will represent grouped effects of multiple receptors from settlements, but will adopt the GLVIA3 approach of identifying representative viewpoints rather than listing all locations.

9.9.4. The LVIA will assess likely effects of the Scheme on each of these representative viewpoints and, by extension, the additional similar viewpoints which may also be similarly impacted by the Scheme.

9.9.5. The LVIA will assess likely effects of the Scheme on the landscape character of the LCA's and LCTs identified within the study area.

9.9.6. The landscape and visual effects of the Scheme will be assessed at the following stages of the development:

- During the Scheme construction period.
- At year one of Scheme opening.
- At 15 years after Scheme opening, allowing time for the contribution of planting or other landscape mitigation to take effect.

9.9.7. The LVIA will comprise, but not limited to, the following:

- Desktop study of existing landscape character assessments both at local level;
- Identification of the baseline character, value and quality of the site and surrounding landscape as well as its susceptibility to the specific change arising from the Scheme;
- Verification of the ZTV - this will help identify receptors and public viewpoints that should be assessed. Assessment locations are to be agreed with environmental stakeholders and consultees. Photographs will be taken at representative viewpoints along with a record of the key landscape and visual characteristics;
- The assessment of impacts from the agreed viewpoints, using photography and where appropriate, photomontages. The nature of existing views will be described for each viewpoint. An assessment of sensitivity of receptor, derived from susceptibility to the specific change and value of view combined with magnitude of effect derived from the scale/extent, duration and reversibility of change in the view, will be used to determine likely overall significance of effect;
- Assessment of impacts on the LCAs. An assessment of sensitivity of character, derived from susceptibility to the specific change and value character combined

with magnitude of effect derived from the scale / extent, duration and reversibility of change in the character will be used to determine likely overall significance of effect;

- The results of the LVIA will be integrated with the cultural heritage, ecological and arboricultural assessments as far is necessary given the degree of overlap; and
- Identification of appropriate mitigation and enhancement proposals to be illustrated on landscape design plan to minimise or reduce impacts.

9.9.8. The assessment will be accompanied by illustrative plans typically showing:

- Topography;
- Zone of Theoretical Visibility;
- Landscape Character;
- Local Designations and Public Rights of Way including National Cycle Routes;
- Viewpoint location plans;
- Representative Photographic Viewpoints; and
- Outline Landscape Design Plans including landscape and environmental mitigation measures.

Landscape Scope

9.9.9. Table 9-1 below lists landscape resource receptors proposed for further consideration within the LVIA (Scoped in) or scoped out from further assessment. This was informed by the option identification stage assessment.

Table 9-1 - Landscape resources scoped in and out for further assessment

Landscape Resources	Scoped IN / OUT	Comments /Justification
Areas of vegetation local to the proposed highway corridors and Junction areas, including woodland, hedgerows, hedgerow trees, tree blocks and individual trees.	IN	The Scheme is likely to result in loss of vegetation along the proposed highway corridor.
Local landscape character features i.e. landform and landscape pattern	IN	These landscape features are likely to be affected by the Scheme through introduction of earthworks and loss of landscape links in the form of boundary vegetation and change of land use.
Landscape character at national and county level.	OUT	The Scheme would not give rise to the alteration of key characteristics of landscape character at the national and regional level.
Effects on Gloucestershire local LCA's SV6B: Vale of Gloucester	IN	Effects on landscape character requires further assessment. The effects would take into consideration key attributes of landscape character area and above listed effects on loss of vegetation, land form, land use and landscape pattern.

Visual Scope

9.9.10. Table 9-2 below lists visual receptors proposed for further consideration within the LVIA (Scoped in) or scoped out from further assessment. This was informed by the option identification stage assessment.

Table 9-2 - Visual receptors scoped in and out for further assessment

Visual Receptor	Scoped IN / OUT	Comments /Justification
The network of PRoWs within 500m of the Scheme including Cheltenham Circular Path	IN	Views from PRoWs are particularly sensitive and the potential effects on their users requires further assessment.
PRoW within AONB particularly on Cleeve Common	IN	Views are possible and significant effects are considered unlikely but due to designation should be considered further.
Properties on Withybridge Gardens	IN	Based on current draft design all of the properties would require demolition.
Properties Withybridge and Laburnum on the A4019. (200 m from existing M5 Junction 10)	IN	Both properties are potentially directly affected.
Properties on Stanboro Lane, Sheldon including Sheldon Nurseries.	IN	Based on current draft design a large proportion of the properties would require demolition.
Properties at Piffs Elm including Stanboro Lane Nurseries, Stanboro Cottage B&B/ fishing lake and The Gloucester Old Spot public house, adjacent Main Road and A4019 junction. (300+ m from existing M5 junction)	IN	Views from the properties have potential to be affected by the Scheme, although effects are not expected to be significant.
Barn Farm, Stanboro Lane. (next to existing M5)	IN	Visual impacts from vegetation removal in MW corridor in close proximity and over longer distance to improved junction roundabout and slip road.
Traveller's site close to the eastern verge of the M5 near Junction 10. (next to existing M5)	IN	Visual impact due to loss of screening vegetation in Motorway verge that may be avoided/mitigated through detail design.
Residents and businesses of Hardwicke. (850 m from any proposed works to the M5)	OUT	Views towards the Scheme options are screened by intervening mature vegetation and trees. Neutral effect expected.
Properties at Colman's Farm (400 m from any proposed works to the M5)	IN	Visual impact due to loss of screening vegetation in Motorway verge that may be avoided/mitigated through detail design.
Properties at Elmstone Hardwicke on Lowdilow Lane and Church Lane. (400 m from any proposed works to the M5)	IN	Visual impact due to loss of screening vegetation in Motorway verge that may be avoided/mitigated through detail design.
Group of properties at Butler's Court, west of Withybridge Lane. (100 m from existing M5, 500 m from the proposed viaduct)	IN	Some visual impact from proposed B4643 link road. Existing vegetation provides some effective screening. Impacts due to Motorway verge works and new roundabout junction and attenuation pond.
Properties at Millhouse Farm, east of Withybridge Lane.	IN	Visual impact from proposed B4643 link road. Existing vegetation provides some

Visual Receptor	Scoped IN / OUT	Comments /Justification
(450 m from existing M5, 150 m from the proposed viaduct)		effective screening, but views are highly likely of the new River Chelt Bridge.
Group of properties at Orchard House and Hayden Farm, at the junction of Withybridge Lane and B4634 Old Gloucester Road. (directly adjacent the new round-a-bout on Old Gloucester Road)	IN	Visual impact from proposed B4643 link road depending upon height of viaduct, and roundabout works. Existing vegetation provides some screening, but views are likely.
The House in the Tree public house and Elm Cottage. At the junction of Withybridge Lane and B4634 Old Gloucester Road. (directly adjacent the new round-a-bout on Old Gloucester Road)	IN	Potential demolition of Elm Cottage. Visual impact from proposed B4643 link road and roundabout works.
Properties at Hayden Hill Fruit Farm, on the Old Gloucester Road. (directly adjacent the new round-a-bout on Old Gloucester Road)	IN	Visual impact from proposed B4643 link road and roundabout works.
Properties off Old Gloucester Road. (Various distances, approx. 500 m from the proposed viaduct over the River Chelt)	IN	Visual impact from proposed B4643 link road. Existing vegetation provides some effective screening.
Properties in Hayden and Hayden Green (250m from the proposed new roundabout on the Old Gloucester Road)	OUT	Views towards the Scheme options are screened by intervening mature vegetation and trees. Neutral effect expected.
Properties on the western edge of Springbank and Springbank Primary Academy. (1 km from the proposed viaduct over the River Chelt)	OUT	Receptor is on edge of the study area. Views towards the Scheme options are screened by intervening mature vegetation and trees. Neutral effect expected.
Properties on Pilgrove Way and Pilgrove Way playground (1 km from the proposed viaduct over the River Chelt)	OUT	Receptor is on edge of the study area. Views towards the Scheme options are screened by intervening mature vegetation and trees. Neutral effect expected.
Hayden Allotments (900 m from the proposed viaduct over the River Chelt. 300 m from works to A4019)	OUT	Receptor is on edge of the study area. Views towards the Scheme options are screened by intervening mature vegetation and trees. Neutral effect expected.
Properties and businesses in Kingsditch. (adjacent eastern end of proposed works to A4019)	IN	Views from the properties have potential to be affected by the Scheme, although effects are not expected to be significant. To be assessed further in the visual assessment.
Properties, Allotments and playing fields in Swindon Village. (1 km from proposed works to the A4019)	OUT	Receptor is on edge of the study area. Views towards the Scheme options are screened by intervening mature vegetation and trees. Neutral effect expected.

Visual Receptor	Scoped IN / OUT	Comments /Justification
Properties in Uckington, south of the A4019. (Directly adjacent the A4019 widening and 500 m approx. from the proposed viaduct over the River Chelt)	IN	Potential demolition of three properties and a farm building. Visual impact from proposed B4643 link road and some encroachment for A4019 properties. Existing vegetation provides some effective screening. Setting for scheduled monument needs careful mitigation.
Properties along west side of The Green, Uckington.	IN	Some impacts from vegetation clearance along A4019 and encroachment of property on A4019
Properties along the A4019, east of Uckington, including residential, business and community facilities. (directly adjacent to the A4019 widening)	IN	Impacts from vegetation clearance, widening and occasional encroachment of land along A4019. Impacts likely to be minor to major depending upon detail design.
Properties in Boddington, including Boddington House, Boddington Manor, Home Farm and St Mary Magdalene Church. (700 m from the existing M5 Junction 10)	IN	Visual impact due to loss of screening vegetation in MW verge that may be avoided/mitigated through detail design.

9.10. Proposed assessment methodology

9.10.1. The methodology to be used for the assessment will be based on guidance set out in DMRB LA 107 Landscape and visual effects, which is applicable to the reporting of environmental assessment of highways and replaces DMRB Volume 11 Section 3 Part 5 Landscape Effects and IAN 135/10. General guidance will be taken from GLVIA and the assessment will be undertaken by Chartered Members of the Landscape Institute.

9.10.2. The methodology ensures that a comprehensive description and evaluation of the baseline landscape character and visual amenity is available for the assessment process. It considers effects in relation to:

- Landscape character and resources, including effects on the aesthetic values of the landscape caused by changes in the elements, characteristics, character and qualities of the landscape;
- Designated landscapes, historic gardens and designed landscapes, and recreational interests; and
- Visual amenity - including effects upon potential viewers and viewing groups caused by changes in the appearance of the landscape as a result of the Scheme.

9.10.3. Landscape characteristics are considered to be of importance in their own right and are valued for their intrinsic qualities irrespective of whether they are seen by people. Impacts on visual amenity are effects as perceived by people and are therefore clearly distinguished from, although closely linked to, impacts on landscape character and resources. Landscape and visual assessments are therefore separate, linked processes.

9.10.4. The sensitivity of the landscape to accommodate change will be considered and whether mitigation would address any of the potential negative effects arising from the Scheme. Analysis of the visible physical landscape (e.g. landform, vegetation etc.) and visible spatial components (e.g. scale, key views) at the baseline stage of the LVIA will help identify broad site constraints and opportunities to be developed within the Scheme.

9.10.5. Recommendations for landscape mitigation to prevent or reduce predicted significant adverse impacts and enhancements will help to refine the design. The assessment will identify any significant residual effects, i.e. those effects which cannot practicably be further reduced through mitigation.

9.10.6. LA 107 provides a methodology for the consideration of significance of identified effects in accordance with the principles set out in LA 104. Potential impacts will be identified and the magnitude of these assessed. Evaluation of the significance of the landscape and visual effects of the Scheme will be deduced from assessing the sensitivity of the landscape and visual receptors against the magnitude of impact, taking into account mitigation.

9.10.7. The landscape sensitivity of receptors/resource in the assessment will be reported in accordance with the criteria provided in Table 9-3.

Table 9-3 - Landscape sensitivity (susceptibility and value) and typical descriptions

Landscape sensitivity (susceptibility and value) of receptor/resource	Typical description
Very High	Landscapes of very high international/national importance and rarity or value with no or very limited ability to accommodate change without substantial loss/gain (i.e. national parks, internationally acclaimed landscapes - UNESCO World Heritage Sites).
High	Landscapes of high national importance containing distinctive features/elements with limited ability to accommodate change without incurring substantial loss/gain (i.e. designated areas, areas of strong sense of place - registered parks and gardens, country parks).
Medium	Landscapes of local or regional recognition of importance able to accommodate some change (i.e. features worthy of conservation, some sense of place or value through use/perception).
Low	Local landscape areas or receptors of low to medium importance with ability to accommodate change (i.e. non-designated or designated areas of local recognition or areas of little sense of place).
Negligible	Landscapes of very low importance and rarity able to accommodate change.

9.10.8. The magnitude of effect (change) will be reported in the assessment in accordance with the criteria provided in Table 9-4.

Table 9-4 - Magnitude and nature of effect on the landscape and typical descriptions

Magnitude of effect (change)		Typical descriptions
Major	Adverse	Total loss or large scale damage to existing landscape character or distinctive features or elements; and/or addition of new uncharacteristic, conspicuous features or elements (i.e. road infrastructure).
	Beneficial	Large scale improvement of landscape character to features and elements; and/or addition of new distinctive features or elements, or removal of conspicuous road infrastructure elements.
Moderate	Adverse	Partial loss or noticeable damage to existing landscape character or distinctive features or elements; and/or addition of new uncharacteristic, noticeable features or elements (i.e. road infrastructure).

Magnitude of effect (change)		Typical descriptions
	Beneficial	Partial or noticeable improvement of landscape character by restoration of existing features or elements; or addition of new characteristic features or elements or removal of noticeable features or elements.
Minor	Adverse	Slight loss or damage to existing landscape character of one (maybe more) key features and elements; and/or addition of new uncharacteristic features and elements.
	Beneficial	Slight improvement of landscape character by the restoration of one (maybe more) key existing features and elements; and/or the addition of new characteristic features.
Negligible	Adverse	Very minor loss, damage or alteration to existing landscape character of one or more features and elements.
	Beneficial	Very minor noticeable improvement of character by the restoration of one or more existing features and elements.
No Change		No noticeable alteration or improvement, temporary or permanent, of landscape character of existing features and elements.

9.10.9. The significance of visual sensitivity will be reported in the assessment in accordance with the criteria provided in Table 9-5

Table 9-5 - Visual sensitivity (susceptibility and value) and typical descriptions

Sensitivity (susceptibility and value)	Typical descriptions
Very High	Static views from and of major tourist attractions; Views from and of very important national/international landscapes, cultural/historical sites (e.g. National Parks, UNESCO World Heritage sites); and Receptors engaged in specific activities for enjoyment of dark skies.
High	Views by users of nationally important PRoW / recreational trails (e.g. national trails, long distance footpaths); Views by users of public open spaces for enjoyment of the countryside (e.g. country parks); Static views from dense residential areas, longer transient views from designated public open space, recreational areas; and Views from and of rare designated landscapes of national importance.
Moderate	Static views from less populated residential areas, schools and other institutional buildings and their outdoor areas; Views by outdoor workers; Transient views from local/regional areas such as public open space, scenic roads, railways or waterways, users of local/regional designated tourist routes of moderate importance; Views from and of landscapes of regional importance.
Low	Views by users of main roads or passengers in public transport on main arterial routes; Views by indoor workers; Views by users of recreational/formal sports facilities where the landscape is secondary to enjoyment of the sport; and Views by users of local public open spaces of limited importance with limited variety or distinctiveness.

Sensitivity (susceptibility and value)	Typical descriptions
Negligible	Quick transient views such as from fast moving vehicles; Views from industrial area, land awaiting re-development; and Views from landscapes of no importance with no variety or distinctiveness.

9.10.10. The magnitude of visual effect will be reported in the assessment in accordance with the criteria provided in Table 9-6.

Table 9-6 - Magnitude (change) of visual effect and typical descriptions

Magnitude (change) of visual effect	Typical descriptions
Major	The project, or a part of it, would become the dominant feature or focal point of the view.
Moderate	The project, or a part of it, would form a noticeable feature or element of the view which is readily apparent to the receptor.
Minor	The project, or a part of it, would be perceptible but not alter the overall balance of features and elements that comprise the existing view.
Negligible	Only a very small part of the project work or activity would be discernible or being at such a distance it would form a barely noticeable feature or element of the view.
No Change	No part of the project work or activity would be discernible.

9.10.11. The approach to deriving effects significance from receptor sensitivity and magnitude will be based on Table 4-1. The descriptions for significance (as outlined in Table 4-2) will be applied to the assessment.

9.10.12. In summary the assessment will follow the following process set out in Table 9-7:

Table 9-7 - Summary of assessment process

Summary of assessment process
Landscape
Baseline; including an assessment of the value of the landscape, both of character areas and features and elements; Assess sensitivity of landscape with reference to its capacity to accommodate change arising from the project; Assess magnitude of impacts on landscape; features, elements and character, with reference to: scheme design, including bridges, approach roads and embankments, scale of change, nature of change; Develop mitigation to reduce potential adverse effects; Evaluate significance of landscape effects; and Report residual landscape effects.
Visual
Baseline; identification of visual receptors and their sensitivity to change which in turn will then be used to identify:- • Key viewpoints in which to carry out more detailed assessments; • Residential properties affected by the proposal; and • Public rights of way or public access land affected by the proposal. Consultation with the statutory bodies and key stakeholders will be carried out at this time to help identify and agree viewpoints that are most characteristics of the area;

Summary of assessment process
Assess magnitude of visual impacts with reference to scheme design, including bridges, approach roads and embankments, scale of change, nature of change; Develop mitigation to reduce potential adverse effects; Evaluate significance of visual effects; and Report residual visual effects for each receptor.

9.10.13. Landscape effects will be assessed by comparing the predicted effects of the Scheme with the situation if the project were not to proceed (i.e. the 'Do Minimum'), using the following scenarios:

- On a winters day during construction when mitigation will be restricted;
- In the winter of the year of opening (to represent a maximum effect situation), taking account of the completed project and the traffic using it; and
- In the summer of the fifteenth year after project opening, taking account of the completed project and the traffic using it.

9.10.14. Visual effects will be assessed using the following scenarios:

- During the construction period, assuming a maximum visibility or maximum perceived change situation (i.e. when construction activity is at its peak for any given view);
- A winter's day in the year that the project would open to traffic or be fully operational. This is usually a reflection of the operationally non-fully mitigated/maximum visibility scenario; and
- A summer's day in the fifteenth year after opening. This is usually a reflection of the near fully mitigated scenario under normal conditions.

9.11. Proposed consultation

9.11.1. It is intended to consult with the local planning authority landscape and/or tree officer or equivalent and a representative from the Cotswold AONB to agree the final scope of the LVIA and any mitigation or enhancement measures that they would like to see considered in the design.

9.12. Conclusion

9.12.1. It is anticipated that in the short term there are likely to be significant landscape and visual effects for a small number of properties, PRoW and very local landscape. In the longer term it is considered that mitigation measures would go some way to reducing the impact of the Scheme and significant effects can be reduced.

10. Geology and Soils

10.1. Introduction

10.1.1. This chapter provides the environmental scoping assessment of the Scheme for geology and soils. The chapter sets out the proposed scope for the geology and soils assessment which will be undertaken in accordance with the methodology set out in the DMRB guidance document LA109: Geology and Soils (Highways England, 2019). This chapter provides a summary of the anticipated geology and soil conditions relevant to the Scheme option, outlines where further assessment is required and identifies potential impacts and mitigation measures.

10.1.2. In line with DMRB LA109, the following aspects have been considered in the scoping assessment:

- Effects on bedrock geology and superficial deposits, including geological designations and sensitive / valuable non-designated features;
- Effects on soil resources; and
- Effects from land contamination on human health, surface water and groundwater.

10.1.3. Effects on mineral deposits as a resource are provided in Chapter 12 (Materials and Waste). Effects associated with water quality are provided in Chapter 8 (Road Drainage and the Water Environment) and effects associated with landform are reported in Chapter 9 (Landscape). Impacts on commercial farming activities utilising the agricultural land are discussed in Chapter 13 (Population and Human Health).

10.2. Study area

10.2.1. To consider the effects associated with land contamination, the study area will include the Scheme footprint within the redline boundary (the Site) and land immediately beyond it to a distance of 500m (off-site). This is considered appropriate for identifying historical and current potentially contaminative land uses which may have resulted in contamination within the route options and the location of sensitive off-site receptors which may be affected by the Scheme.

10.2.2. The study area to consider effects on geology and soil resources will be the land required for the permanent engineering footprint of the Scheme, including associated embankment and slip-roads and small areas (i.e. on new roundabouts) where the land can no longer be utilised as a resource.

10.3. Planning policy and topic legislative context

10.3.1. The geology and soils assessment will be undertaken with due consideration to the following policy, legislation and guidance.

National Policy

National Policy Statement for National Networks (NN NPS, 2014)

10.3.2. The Scheme falls within the definition of an NSIP, making the NN NPS the primary planning policy against which an application for a DCO for the Scheme would be judged.

10.3.3. Paragraph 5.22 of the NN NPS relates to sites of geological importance and states that where the project is subject to EIA the applicant should ensure that the environmental statement clearly sets out any likely significant effects on internationally, nationally and locally designated sites of ecological or geological conservation importance.

10.3.4. Furthermore, paragraph 5.25 states that development should avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives.

10.3.5. Paragraph 5.168 of the NN NPS relates to soils resources and land contamination and states that applicants should take into account the benefits of the best and most versatile (BMV) agricultural land. Where significant development of agricultural land is demonstrated to be necessary, applicants should seek to use areas of poorer quality land in preference to that of a higher quality. Applicants should also identify any effects, and seek to minimise impacts on soil quality, taking into account any mitigation measures proposed. Where possible, developments should be on previously developed (brownfield) sites. For developments on previously developed land, applicants should ensure that they have considered the risk posed by land contamination.

10.3.6. Paragraph 5.179 also states that applicants should minimise the direct effects of a project by the application of good design principles, including the layout of the project and the protection of soils during construction.

National Planning Policy Framework (Ministry of Housing, Communities and Local Government, 2019)

10.3.7. Given that the Scheme is an NSIP, the NPPF has the status of a material consideration in planning terms.

10.3.8. Paragraph 170 of the National Planning Policy Framework (NPPF) is of particular relevance to geological and soil conservation, stating that policies and decisions should contribute to and enhance the natural and local environment by protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan) as well as recognising the economic and other benefits of the BMV agricultural land, and of trees and woodland.

10.3.9. Paragraph 170 also states that plans should prevent new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Where significant development of agricultural land is demonstrated to be necessary, local planning authorities should seek to use areas of poorer quality land in preference to that of higher quality.

10.3.10. Paragraph 178 states that policies and decisions should ensure that a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination.

10.3.11. Building on the NPPF, Planning Practice Guidance published in June 2014 provides the guiding principles on how planning can deal with contaminated land.

Environmental Protection Act (United Kingdom Government, 1990)

10.3.12. Part 2A of the Environmental Protection Act (EPA) 1990 (United Kingdom Government, 1990) introduced a statutory regime for the identification and remediation of 'Contaminated Land'. It provides a statutory definition of 'Contaminated Land' based on significant harm or the likelihood of significant harm or significant pollution or significant possibility of such pollution of controlled waters (all groundwater, inland waters and estuaries, excluding water perched above the zone of saturation).

10.3.13. Local authorities are the primary regulators under the Part 2A regime, with a duty to identify whether the land in their area is 'Contaminated Land', although provision is made for consultation and co-ordination with the Environment Agency in situations when pollution of controlled waters is an issue.

Contaminated Land Statutory Guidance (DEFRA, 2012)

10.3.14. The principal objectives of the legislation are described in the DEFRA Contaminated Land Statutory Guidance 2012 (DEFRA, 2012), as follows:

- Identify and remove unacceptable risks to human health and the environment;

- Seek to ensure that contaminated land is made suitable for its current use; and
- Ensure that the burdens faced by individuals, companies and society as a whole are proportionate, manageable and compatible with the principles of sustainable development.

10.3.15. These three objectives underlie the 'suitable for use' approach to the assessment and remediation of 'land contamination'. This approach recognises that the risks presented by any given level of land contamination will vary greatly according to the use of the land and a wide range of other factors, such as the sensitivity of the underlying geology and the receptors which may be affected. The 'suitable for use' approach consists of three elements:

- Ensuring that land is suitable for its current use;
- Ensuring that land is made suitable for any new use; and
- Limiting requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to the current use or future use of the land.

The Water Resources Act 1991 (as amended)

10.3.16. The Water Resources Act (United Kingdom Govenment Legislation, 1991) sets controls of pollution of water sources in Section III. It contains information about water quality objectives, powers to prevent and control pollution, and pollution offences.

Environment Agency's approach to groundwater protection

10.3.17. The Environment Agency's approach to groundwater protection contains position statements on Source Protection Zone (SPZ) areas identified as drinking water protected areas and aquifer designations. It states that:

- The development of infrastructure should be directed to less sensitive groundwater locations;
- The Environment Agency will use a risk based tiered approach to regulate activities that may impact groundwater resources; and
- The Environment Agency expects developers and operators to consider all current and future groundwater uses and their dependent ecosystems.

Water Framework Directive (DEFRA, 2015)

10.3.18. The purpose of the Water Framework Directive (WFD) (DEFRA, 2015) as enacted by the Water Resources (Water Framework Directive) (England and Wales) Regulations (United Kingdom Government, 2017), is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater. It requires that:

- Environmental objectives should be set to ensure that good status of groundwater is achieved and that its deterioration is avoided. This includes that any upward sustaining trend in the concentration of a pollutant must be identified and reversed;
- A good status of groundwater requires early action and stable long-term planning of protective measures, owing to the natural time lag in its formation and renewal; and
- Monitoring programmes should cover monitoring of the chemical and quantitative status of groundwater.

River Basin Management Plan (Environment Agency, 2015)

10.3.19. The River Basin Management Plan (RBMP) (Environment Agency, 2015) is designed to protect and improve the quality of the water environment. It includes consideration of the following topics:

- Plans for the protection and improvement of the water environment;
- Future plans that may affect the infrastructure sector and its obligations;

- Development proposal considerations regarding the requirements of the RBMP; and
- Environmental permit applications.

Local Policy

Joint Core Strategy (JCS) 2011-2031 (Gloucester City, Cheltenham Borough and Tewkesbury Borough Council, 2017)

10.3.20. The key policies of the JCS relevant to geology and soils are:

- Policy SD9: Biodiversity and Geodiversity: The purpose of the policy is to ensure that individual assets and the quality of the natural environment in the future is planned, protected and enhanced at a strategic scale, recognising that networks extend across local authority boundaries. Harm to the biodiversity or geodiversity of an undesignated site or asset should be avoided where possible. Where there is a risk of harm as a consequence of development, this should be mitigated by integrating enhancements into the Scheme that are appropriate to the location.'
- Policy SD14: states new development must consider the quality and versatility of any agricultural land affected by proposals, recognising that the best agricultural land is a finite resource.
- Policy SD16: Health and Environmental Quality: A new development must consider the quality and versatility of any agricultural land affected by proposals, recognising that the best agricultural land is a finite resource.

Guidance Documents

10.3.21. The following guidance documents have been considered:

- Contaminated Land: Applications in Real Environments – The Definition of Waste: Development Industry Code of Practice (DoWCoP) (CL:AIRE, 2011);
- The Design Manual for Roads and Bridges (DMRB) Volume 11, Section 2, LA 104 Sustainability and Environment Appraisal. Environmental assessment and monitoring (DMRB, 2019);
- DMRB Volume 11, Section 3, LA 109 Geology and Soils (DMRB, 2019);
- Department of the Environment (DoE) Industry Profiles for previously developed land, Environment Agency (Environment Agency, 1995);
- Environment Agency report R&D66 (Environment Agency and NHBC, 2008);
- Land Contamination: Risk Management (LCRM) (Environment Agency, 2019);
- The Guiding Principles for Land Contamination (GPLC) (Environment Agency, 2010);
- The Department for Food and Rural Affairs (DEFRA) Safeguarding our Soils – A Strategy for England (Defra, 2009);
- Technical Information Note 049 (TIN049) (Natural England, 2012);
- Construction Industry Research and Information Association (CIRIA) C552 Contaminated Land Risk Assessment – A Guide to Good Practice (CIRIA, 2001);
- CIRIA C665 Assessing Risks Posed by Hazardous Ground Gases to Buildings (CIRIA , 2007);
- British Standards BS 8485+A1:2019 – Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (British Standards, 2015);
- CIRIA C681 Unexploded Ordnance (UXO) – A Guide for the Construction Industry (CIRIA, 2009);
- CIRIA C733 Asbestos in Soil and Made Ground: A Guide to Understanding and Managing Risks (CIRIA , 2014);
- CIRIA C682 The Volatile Organic Contaminants Handbook (CIRIA , 2009);

- British Standards BS 5930+A1:2020 – Code of practice for ground investigations (British Standards, 2015); and
- British Standards BS 10175:2011+A2:2017 – Code of Practice for Investigation of Potentially Contaminated Sites (British Standards, 2017).

10.4. Baseline conditions

10.4.1. This section provides a summary of the baseline environmental characteristics within the study area. The baseline information has been summarised from the M5 Junction 10 Improvement Preliminary Sources Study Report (PSSR), July 2020 (Atkins, 2020a), and the M5 Junction 10 Improvement Preliminary Environmental Assessment of Options Report (PEAOR) (Atkins, 2019).

Geology

10.4.2. Two areas of mapped artificial ground are present within the study area. Artificial ground is located in the north of the study area, approximately 100 m north of M5 Junction 10 parallel to the M5 associated with the historic Colman Farm landfill. An area of worked ground (void) associated with an unspecified man-made excavation is also present in the south east of the study area adjacent to the A4019, approximately 215 m to the south east of M5 Junction 10.

10.4.3. Superficial deposits of Cheltenham Sand and Gravel and Alluvium are present along the alignment of the existing watercourses. Charmouth Mudstone bedrock underlies the majority of the study area with the Rugby Limestone Member present in the south east of the study area.

Mining activity and quarrying

10.4.4. The study area for M5 Junction 10 is not located within an area affected by coal mining.

10.4.5. Three areas licenced for mineral extraction are recorded adjacent to the A4019 approximately 400 m to 1.0 km south east of the site, with the area mapped in closest proximity likely to be the worked ground (void) indicated by BGS mapping.

Environmental Designations

10.4.6. There are no statutory environmental designations for geology or soils within the study area. However, the site is shown to be located within the non-statutory Gloucestershire Green Belt (Tewkesbury district). Areas of Deciduous Woodland are also present around Junction 10 which are designated as Priority Habitats and/or National Forest Inventory sites.

Hydrogeology

10.4.7. The superficial Alluvium and Cheltenham Sand and Gravel are classified as high vulnerability secondary A aquifers. The bedrock Charmouth Mudstone Formation is classified as a medium vulnerability secondary undifferentiated aquifer (unproductive) and the Rugby Limestone Member as a high vulnerability secondary A aquifer.

10.4.8. The study area is not located within a SPZ. There are no licenced groundwater abstractions within the study area, although private unlicenced abstractions may be present.

Hydrology

10.4.9. Two main rivers intersect the study area, the River Chelt to the south of M5 Junction 10 and Leigh Brook to the north. Both rivers flow in a westerly direction joining the River Severn approximately 5.3 km west of the study area. There are no licensed surface water abstractions on site, although private unlicenced abstractions may be present

10.4.10. The Scheme has been identified as being at high risk from flooding activities, with the area to the south of M5 Junction 10 surrounding the River Chelt known to be a historic River Severn flood plain with recorded flood events.

10.4.11. Environment Agency mapping indicates the Scheme to be at risk of flooding by rivers or sea with the land surrounding the River Chelt designated as a Flood Zone 2 (0.1-1% chance of flooding within any given year) and Flood Zone 3 (>1% chance of flooding within any given year) areas.

10.4.12. Further information on flooding is described in Chapter 8 (Road Drainage and the Water Environment).

Contaminated Land

Historic Landfill Sites

10.4.13. There are two historic landfill sites located within the study area at the following locations:

- Approximately 90 m north of the site adjacent to the M5 northbound carriageway (Colman's Farm landfill). The site was licensed between 31 July 1970 and 2 September 1972 and accepted household waste. The landfill also accepted excavated natural material, soil and sub-soil waste from 1st May 1992. No end date for this record is provided; however, the licence is listed as 'known to be surrendered'. Colemans Farm Borrow Pit at the same location was licensed between 30 June 1992 to 31 December 1992 and accepted inert, industrial, commercial and household waste; and
- Approximately 180 m southeast of site boundary adjacent to the A4019 (Violet Villa, likely to be the worked ground (void) indicated by BGS mapping). The site accepted inert waste and liquid sludge from 30 September 1967 with no closure date provided.

Waste Transfer, Treatment and Disposal Sites

10.4.14. There are two registered waste transfer sites recorded within the study area located 460 m south of Uckington and the A4019 (Arle Nursery: non-toxic horticultural waste) and 430 m south of the A4019 (G & D Paints Ltd: cellulose thinners).

10.4.15. Elicot Ltd located 500 m west of the M5 Junction 10 at Piffs Elm, holds licenced records as a waste management facility for household, commercial and industrial waste transfer, as well as being a registered waste incineration disposal site.

Fuel stations

10.4.16. One fuel station is situated adjacent to the west of the Coombe Hill junction (A38/A4019).

Pollution incidents

10.4.17. Data indicates there have been six recorded pollution incidents to controlled waters within the study area. A summary of these incidents is provided below:

- An incident took place in 1995, 250 m west of the A4019 and 420 m east of the M5 carriageway related to a Category 3 minor characterisation for spillage of oils at Millhouse Farm;
- An incident was recorded at Boddington in 1996, 350 m west of Junction 10 of the M5 related to a Category 3 minor characterisation for spillage of oils;
- In 1998, a Category 3 minor release of oils was recorded on the carriageway of the A4019 at Uckington;
- An incident 450 m south of the A4019 at Uckington involving release of red diesel into the River Chelt was recorded as a Category 3 minor incident in 1999;
- In 1996, a Category 3 minor incident was recorded adjacent to Homecroft Drive, 320 m south of the A4019 related to an 'unknown' pollutant affecting the River Chelt; and

- A Category 3 minor incident was recorded in 1998 relating to the presence of two drums (possibly oil) in the River Chelt, 320 m south of the A4019 near Appleyard Close.

Quality of soils and agricultural land

Soil data

10.4.18. The only published soil map for the study area is the 1:250,000 scale National Soil Map of England and Wales, Sheet 5, South West England (Soil Survey of England and Wales, 1983), which illustrates the soil associations present in the region.

10.4.19. The map displays soils of the Badsey association, present on the Cheltenham Sand and Gravel Deposit. These are well drained, calcareous loamy soils over limestone gravel. The Alluvium of the River Chelt is the Fladbury association of clayey soils with a high watertable. The soils of the Charmouth Mudstone Formation are the Evesham association of slowly permeable clay soils. However, in the vicinity of the Cheltenham Sand and Gravel Deposit, the topsoils are lighter, improving their structure and drainage.

Agricultural Land Classification

10.4.20. The agricultural land in the north-east quadrant of Junction 10 is identified on the Joint Core Strategy Key Diagram (Gloucester City, Cheltenham Borough and Tewkesbury Borough Council, 2017) as a Safeguarded Area.

10.4.21. The quality of agricultural land is assessed using the Ministry of Agriculture, Fisheries and Food (MAFF) guidance on agricultural land classification (ALC) (MAFF, 1988). The grading system ranges from grades 1-5 (1 being the highest quality), with grade 3 being divided into subgrades 3a and 3b. ALC grades 1 and 2 and subgrade 3a are considered Best and Most Versatile (BMV) agricultural land.

10.4.22. There has been some surveying of the study area post-1988 for informing ALC. Land which has been surveyed is to the west of the M5, but not including the north-west quadrant of Junction 10. Approximately 15 ha of subgrade 3a (BMV) has been mapped immediately south-west of Junction 10, presumably due to the influence of the Cheltenham Sand and Gravel Deposit on lightening the topsoil. Elsewhere to the west of the M5, on the Alluvium of the river Chelt and the Charmouth Mudstone, the land has mostly been graded as subgrade 3b.

10.4.23. The published MAFF 1:250,000 Provisional ALC Map (Natural England, 2019) can be used to identify the likely ALC grades of the non-surveyed area, but cannot be used conclusively for sites smaller than 80 ha. Moreover, the published map does not subdivide grade 3 into subgrades 3a and 3b and so it cannot be used definitively in areas that are marginal to BMV. The land affected by the Scheme which has not been surveyed is shown on the provisional ALC map as mainly grade 3 (good to moderate quality), except on the Cheltenham Sand and Gravel on either side of the A4019 to the east of Junction 10, where the provisional ALC grades are shown as 1 and 2 (BMV). The provisional ALC grade is considered suitable to fill data gaps for this scoping assessment, with the assumption that land provisionally assigned grade 3 by Natural England which overlay the Chelthenham Sand and Gravel Deposit is likely to be of BMV agricultural land (subgrade 3a), with the land directly on alluvium or mudstone likely to be of non-BMV land (subgrade 3b). The likely BMV land extends for around 500 m south of the A4019 and is therefore likely to be affected by the proposed B4634 connecting road. ALC grades and predicted BMV land are illustrated on Figures 10-1 and 10-2 of the PEAOR (Atkins, 2019).

10.4.24. Climatic data (considered when assigning an ALC grade) have been obtained from the Met. Office climatological data handbook for SO900250 (The Met Office, MAFF, Soil Survey and Land Research Centre, 1989), approximately 760 m south west from Junction 10. The average annual rainfall is 624 mm and the field capacity days (FCD) are 138 at this location. Although climate data are available, no site-specific site information or soil data are available for land to the east of the M5 or to the north west of Junction 10 and so the ALC will be assigned at a later stage within the EIA process once a survey has been

completed. Much of the land to the south of the A4019 is mapped as being within a Flood Zone 3 or a Flood Zone 2 which may limit the ALC grade.

Soils of other importance

10.4.25. There are no EU designated sites, UK designated sites (e.g. Special Protection Area (SPA), Ramsar) or non-statutory designated sites (e.g. Local Geological Sites, Local Nature Reserves) present within the soils and agricultural land study area, where sensitive soils could be directly affected. Areas of Deciduous Woodland are present around Junction 10 which are designated as Priority Habitats and/or National Forest Inventory sites. However, the soils within these areas are not considered to be significantly or uniquely important to the development or support of these habitats and can therefore be scoped out from the geology and soils assessment. The impact to these areas from a biodiversity perspective is described in Chapter 7 (Biodiversity).

10.5. Assumptions and limitations

Land Contamination

10.5.1. Assumptions on ground conditions and land contamination impacts has been made based on the data available at the time or reporting and current understanding of proposed route options. Information for geology and land contamination has been sourced from desk-based available information only.

Soils and Agricultural Land

10.5.2. The soils and agricultural land scoping assessment is based on the expected current ground conditions in the study area using published information. A soil survey will be completed to assign the ALC grade to the identified data gaps within the study area for interpretation in the detailed assessment within a later stage of the EIA.

10.6. Potential impacts

Land Contamination

10.6.1. Potential impacts of the Scheme are expected to include the following types of impacts:

- Effects associated with existing ground contamination and potential new ground contamination issues; and
- Effects associated with the re-use or disposal of site sourced soils and waste soils.

Soils and Agricultural Land

10.6.2. The potential impacts of the Scheme are the physical removal of a soil resource or agricultural land, the permanent sealing of a soil resource or agricultural land, permanent or temporary loss or the reduction of one or more soil functions or restriction to current or approved future use (e.g through degradation, compaction or erosion).

10.7. Potential effects and mitigation measures

Land Contamination

10.7.1. The construction phase could potentially introduce new sources of contamination and disturb and mobilise existing sources of contamination. Construction activities, such as excavation, trenching, tunnelling and piling may introduce new pathways for migration of existing contamination and exposure of contaminated soil, remobilisation of contaminants through soil disturbance and the creation of preferential pathways for surface water run-off and ground gas migration.

10.7.2. Potential changes to the baseline situation which could create potential contaminant linkages for the construction phase include:

- The potential for mobilising contaminants by excavation and stockpiling of material, increasing the risk to controlled water receptors through leaching and run-off. Earthworks could provide opportunities for run-off to contain suspended solids, if not carried out in line with required management procedure;
- The potential for introducing new sources of contamination i.e. from spillages and leaks;
- The potential for exposure of human receptors by generation of potentially contaminated dust and vapours released by the construction works; and
- The potential for creation of new pathways to groundwater during groundworks, through opening up ground temporarily and construction activities, such as earthworks, piling, installation of drainage and other below-ground services.

10.7.3. The operation of the Scheme would potentially introduce new sources of contamination. Spillages and leaks may occur from machinery and below ground services and leakage from the pipeline and wetland retaining structure could create additional potential pathways for the migration of potential contamination that were not present at baseline.

10.7.4. Waste soils would be generated during construction through excavation works. There is the potential that waste soil generated during construction would be classified as unsuitable for re-use on-site or hazardous, therefore requiring removal from site.

10.7.5. The Scheme may also generate limited waste soils during operation due to maintenance requirements which may include excavations for landscaping, repairs and maintenance of services.

10.7.6. Design, mitigation and enhancement measures will be identified for the potential land contamination impacts. Where significant environmental effects are identified in the assessment, mitigation that will potentially be considered within the design include changes to the vertical alignment, alternative foundation options, development of piling risk assessments, earthworks and materials management or use of lined drainage.

10.7.7. Other post-design mitigation measures will include the development and use of appropriate Risk Assessment, Method Statements and a Construction Environmental Management Plan (CEMP), and adherence to good site working practices, in accordance with relevant legalisation and guidance.

Soils and Agricultural Land

10.7.8. The main impact of the Scheme would be the permanent loss of agricultural land, which for the proposed improvement works to Junction 10 and new link road from the A4019 to the B4634 is estimated to require some 24 ha. This is considered a major magnitude of impact.

10.7.9. Based on the available information, the land quality varies across the study area, with BMV (subgrade 3a) and non-BMV (subgrade 3b) present and provisionally grade 1 and grade 2. These ALC grades range from a medium to very high receptor value. A soil survey is required in order to identify the ALC grade for areas which have not been surveyed to complete a detailed assessment.

10.7.10. Where significant development of agricultural land is demonstrated to be necessary, land take options should seek to use areas or poorer quality land in preference to that of a higher quality land. Effects should be identified and design should seek to minimise impacts on soil quality, taking into account any mitigation measures proposed as instructed in the NN NPS (Department for Transport, 2014). There are no effective measures to mitigate permanent loss of agricultural land. If the Scheme results in the loss of BMV agricultural land, then the proposed development and relevant documents should demonstrate every effort has been made to reduce the magnitude of impact and favour development on lower grade agricultural land.

10.7.11. A Soil Handling Management Plan would be produced prior to any development to ensure that the quality of soil in areas required temporarily for the proposed developed is

maintained by following best practice guidance on soil handling. The findings of the proposed soil survey would inform the Soil Handling Management Plan. In addition, best practice construction methods would be included in the CEMP to provide methods of minimising the temporary loss or reduction of soil functions (i.e. dust mitigation measures).

10.8. Likely residual effects

Land Contamination

10.8.1. With the implementation of mitigation measures, residual effects for land contamination impacts are considered to be neutral.

Soils and Agricultural Land

10.8.2. With the implementation of mitigation measures, temporary use of agricultural land for construction will have no residual effects. The permanent land take for the Scheme is anticipated to have between a moderate or large to very large residual effect and expected to be significant. Further assessment including the identification of the ALC grade of unsurveyed land and a detailed review of the design (land take areas) is required. The method of the assessment is provided in Section 10.10.10.

10.9. Proposed level and scope of assessment

10.9.1. This geology and soils assessment will be undertaken in accordance with the methodology set out in the DMRB guidance document LA109: Geology and Soils (Highways England, 2019).

10.9.2. The following aspects will be considered in the assessment:

- Effects on soil resources; and
- Effects from contamination on human health, surface water and groundwater.

10.9.3. Effects on bedrock geology and superficial deposits, including geological designations and sensitive / valuable non-designated features have been scoped out of the assessment.

10.9.4. Soils of other importance have also been scoped out of the soils and agricultural land assessment.

10.10. Proposed assessment methodology

Land Contamination

10.10.1. The assessment of land contamination will follow the DMRB LA109 (DMRB, 2019) guidance and will be undertaken over two stages including:

- Stage 1 – compilation of baseline data and a land contamination risk assessment; and
- Stage 2 – a land contamination impact assessment.

Stage 1 – Contamination Risk Assessment

10.10.2. A PSSR (Atkins, 2020a) has been completed for the Scheme and will be used to inform the baseline information for the environmental assessment. As part of the PSSRs, Preliminary Conceptual Site Models have been developed.

10.10.3. Collection of geo-environmental data from site investigations may also be required to support further assessment, as recommended in the PSSR.

Stage 2 – land contamination impact assessment

10.10.4. The impact assessment will be undertaken using the methodology outlined in the following sections.

Value / Sensitivity

10.10.5. A sensitivity/value will be assigned to each receptor using the criteria detailed in Table 10-1. For human health receptors, DMRB guidance document LA 109 (DMRB, 2019) has been used to define the receptor value. To assess surface water and groundwater receptors, DMRB guidance document LA 113 (DMRB, 2020) for road drainage and the water environment has been applied.

Table 10-1 - Environmental value (sensitivity) and descriptions

Receptor Value (Sensitivity)	Description
Human Health (DMRB, 2019)	
Very High	Very high sensitivity land use such as residential or allotments
High	High sensitivity land use such as public open space
Medium	Medium sensitivity land use such as commercial or industrial
Low	Low sensitivity land use such as highways and rail
Negligible	Undeveloped surplus land / no sensitive land use proposed
Groundwater (DMRB, 2020)	
Very High	Principal aquifer providing a regionally important resource and/or supporting a site protected under EC and UK legislation LA 108 (DMRB, 2020) Groundwater locally supports Groundwater Dependent Terrestrial Ecosystems (GWDTE) SPZ 1
High	Principal aquifer providing locally important resource or supporting a river ecosystem. Groundwater supports a GWDTE SPZ 2
Medium	Aquifer providing water for agricultural or industrial use with limited connection to surface water SPZ3
Low	Unproductive strata
Negligible	N/A
Surface Water (DMRB, 2020)	
Very High	Watercourse having a WFD classification shown in a RBMP and Q95 ≥ 1.0 m^3/s. Site protected/designated under European Commission (EC) or UK legislation (Special Area of Conservation, SPA, SSSI Ramsar site, salmonid water) / Species protected by EC legislation LA 108 (DMRB, 2020)
High	Watercourse having a WFD classification shown in a RBMP and Q95 <1.0m^3/s. Species protected under EC or UK legislation LA 108 (DMRB, 2020)
Medium	Watercourses not having a WFD classification shown in a RBMP and Q95 >0.001m^3/s
Low	Watercourses not having a WFD classification shown in a RBMP and Q95 ≤0.001m^3/s
Negligible	N/A

Magnitude

10.10.6. Following determination of the value/sensitivity of the receptors, the magnitude of potential impacts are determined. The criteria for the assessment of impact magnitude is set out in Table 10-2.

Table 10-2 - Magnitude of impact and typical descriptions

Magnitude of Impact (change)	Description
Human Health (DMRB, 2019)	
Major	Significant contamination identified. Contamination levels significantly exceed background levels and relevant screening criteria with potential for significant harm to human health. Contamination heavily restricts future use of land.
Moderate	Contaminant concentrations exceed background levels and are in line with limits of relevant screening criteria. Significant contamination can be present. Control / remediation measures are required to reduce risks to human health / make land suitable for intended use.
Minor	Contaminant concentrations are below relevant screening. Significant contamination is unlikely with a low risk to human health. Best practice measures can be required to minimise risks to human health.
Negligible	Contaminant concentrations substantially below levels outlined in relevant screening criteria. No requirement for control measures to reduce risks to human health / make land suitable for intended use.
No change	Reported contaminant concentrations below background levels.
Groundwater (DMRB, 2020)	
Major adverse	Loss of, or extensive change to, an aquifer. Loss of regionally important water supply. Potential high risk of pollution to groundwater from routine runoff - risk score >250 (groundwater quality and runoff assessment). Calculated risk of pollution from spillages ≥2% annually (spillage assessment). Loss of, or extensive change to GWDTE or baseflow contribution to protected surface water bodies. Reduction in water body WFD classification. Loss or significant damage to major structures through subsidence or similar effects.
Moderate adverse	Partial loss or change to an aquifer. Degradation of regionally important public water supply or loss of significant commercial/ industrial/ agricultural supplies. Potential medium risk of pollution to groundwater from routine runoff - risk score 150-250. Calculated risk of pollution from spillages ≥1% annually and <2% annually. Partial loss of the integrity of GWDTE. Contribution to reduction in water body WFD classification. Damage to major structures through subsidence or similar effects or loss of minor structures.
Minor adverse	Potential low risk of pollution to groundwater from routine runoff - risk score <150. Calculated risk of pollution from spillages ≥0.5% annually and <1% annually. Minor effects on an aquifer, GWDTEs, abstractions and structures.

Magnitude of Impact (change)	Description
Negligible	No measurable impact upon an aquifer and/or groundwater receptors and risk of pollution from spillages <0.5%.
Minor beneficial	Calculated reduction in existing spillage risk by 50% or more to an aquifer (when existing spillage risk <1% annually). Reduction of groundwater hazards to existing structures. Reductions in waterlogging and groundwater flooding.
Moderate beneficial	Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is >1% annually). Contribution to improvement in water body WFD classification. Improvement in water body catchment abstraction management Strategy (CAMS) (or equivalent) classification. Support to significant improvements in damaged GWDTE.
Major beneficial	Removal of existing polluting discharge to an aquifer or removing the likelihood of polluting discharges occurring. Recharge of an aquifer. Improvement in water body WFD classification.
No change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.
Surface Water (DMRB, 2020)	
Major adverse	Failure of both acute-soluble and chronic-sediment related pollutants in HEWRAT and compliance failure with Environmental Quality Standard (EQS) values. Calculated risk of pollution from a spillage ≥2% annually (spillage assessment). Loss or extensive change to a fishery. Loss of regionally important public water supply. Loss or extensive change to a designated nature conservation site. Reduction in water body WFD classification.
Moderate adverse	Failure of both acute-soluble and chronic-sediment related pollutants in Highways England Water Risk Assessment Tool the Highways England Water Risk Assessment Tool (HEWRAT) but compliance with EQS values. Calculated risk of pollution from spillages ≥1% annually and <2% annually. Partial loss in productivity of a fishery. Degradation of regionally important public water supply or loss of major commercial/industrial/agricultural supplies. Contribution to reduction in water body WFD classification.
Minor adverse	Failure of either acute soluble or chronic sediment related pollutants in HEWRAT. Calculated risk of pollution from spillages ≥0.5% annually and <1% annually. Minor effects on water supplies.
Negligible	No risk identified by HEWRAT (pass both acute-soluble and chronic-sediment related pollutants). Risk of pollution from spillages <0.5%.
Minor beneficial	HEWRAT assessment of either acute soluble or chronic-sediment related pollutants becomes pass from an existing site where the baseline was a fail condition.

Magnitude of Impact (change)	Description
	Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is <1% annually).
Moderate beneficial	HEWRAT assessment of both acute-soluble and chronic-sediment related pollutants becomes pass from an existing site where the baseline was a fail condition. Calculated reduction in existing spillage by 50% or more (when existing spillage risk >1% annually). Contribution to improvement in water body WFD classification.
Major beneficial	Removal of existing polluting discharge or removing the likelihood of polluting discharges occurring to a watercourse. Improvement in water body WFD classification.
No change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.

Effect Definitions

10.10.7. The overall significance of land contamination effects is defined using the matrix presented above in Table 4-1 as per DMRB LA 104 (DMRB, 2019), which describes the relationship between the value/sensitivity of the receptor and the magnitude (change) of the impact.

10.10.8. In alignment with DMRB guidance, where two potential values of significance of effect are identified using the matrix in Table 4-1, professional judgement will be used to assign the value based on understanding of details of both the magnitude of impact and value of the receptor. For example, where a minor impact is identified in relation to a receptor of high sensitivity, professional judgement will be used to determine whether this results in a slight or moderate effect.

10.10.9. Following the classification of an effect, a clear statement is made as to whether the effect is 'significant' or 'not significant'. As a general rule, moderate to very large effects are considered to be significant.

Soils and Agricultural Land

10.10.10. The detailed assessment of soils and agricultural land will follow DMRB LA109 (DMRB, 2019) guidance for assessing impacts to agricultural soils. Section 3.6.1 of DMRB LA109 states that a soil resource and/or ALC survey should be undertaken to inform the EIA where data is incomplete.

10.10.11. Table 10-3 describes how to assign value (sensitivity) to soil receptors. An agricultural soil receptor can be assigned a sensitivity value based on its ALC grade. BMV agricultural land comprises soils graded in the ALC system as Grade 1, 2 and Subgrade 3a (MAFF, 1988).

10.10.12. Soils not within BMV agricultural land, nor within an area of recognised environmental/ ecological interest, can be allocated a higher sensitivity value where particular agricultural practices contribute to the quality and character of the environment or local economy. This exception is not known at this stage as a site visit and/ or soil survey would be required to inform this.

10.10.13. Other potentially sensitive soils to be considered in the assessment include those supporting recognised sites of environmental/ecological interest. As reported in Section 10.4.25, there are no such recognised sites within the soils study area.

Table 10-3 - Assigning receptor value (sensitivity) (DMRB, 2019)

Receptor value (sensitivity)	Description
Very high	Land in ALC Grades 1 & 2.

High	ALC Subgrade 3a.
Medium	ALC Subgrade 3b.
Low	ALC Grades 4 & 5.
Negligible	Previously developed land formerly in hard uses with little potential to return to agriculture.

10.10.14. Table 10-4 provides guidance on how to assign magnitude of impact to soils in the study area.

Table 10-4 - Assigning magnitude of impact (DMRB, 2019)

Magnitude of impact	Typical description
Major	Physical removal or permanent sealing of >20ha of agricultural land.
Moderate	Physical removal or permanent sealing of 1ha - 20ha of agricultural land. Permanent loss/reduction of one or more soil function(s) and restriction to current or approved future use (e.g. through degradation, compaction, erosion of soil resource).
Minor	Temporary loss/reduction of one or more soil function(s) and restriction to current or approved future use (e.g. through degradation, compaction, erosion of soil resource).
Negligible	No discernible loss/reduction of soil function(s) that restrict current or approved future use or permanent sealing of <1ha.
No change	No changes are anticipated for the area.

10.10.15. The significance of effect on the agricultural soil is determined by a combination of the magnitude of the impact and the value (sensitivity) of each receptor. Table 4-1 is a reproduction of Table 3.8.1 from DMRB LA104 (DMRB, 2019) and presents the matrix for determining the significance of an effect. Consideration will be given in the assessment to influential factors which are listed below.

10.10.16. The assessment of the significance of residual effects will consider possible mitigation measures.

10.10.17. In alignment with DMRB guidance, where two potential values of significance of effect are identified using the matrix in Table 4-1, professional judgement will be used to assign the value based on understanding of details of both the magnitude of impact and value of the receptor. For example, where a minor impact is identified in relation to a receptor of high sensitivity, professional judgement will be used to determine whether this results in a slight or moderate effect.

10.10.18. In general, moderate to very large effects are to be considered significant in terms of the EIA Regulations 2017. Consultation with Natural England will be carried out as the Scheme exceeds 20 ha in land take.

10.11. Proposed consultation

Land contamination

10.11.1. As part of the EIA, consultation will be undertaken with the Local Authority Contaminated Land Officer and Environment Agency as required.

Soils and Agricultural Land

10.11.2. TIN049 (Natural England, 2012) and DMRB LA 109 state that specific consultations with Natural England are required in relation to BMV agricultural land. Consultation should be undertaken if (i) the development is not for agricultural purposes (ii) the development is

not in accordance with the provisions of a development plan and (iii) the development involves the loss of not less than 20 hectares (ha) of BMV agricultural land which is used/was last used for agricultural purposes. Based on the above conditions, consultation is required and will commence at a later stage of the EIA.

10.12. Conclusion

10.12.1. The scoping has identified the study area for geology and soils, presented a summary of the existing baseline information, identified potential effects and mitigation during construction and operation and presented the proposed scope and methodology for the environmental assessment.

10.12.2. The following aspects will be considered in the assessment:

- Effects on soil resources; and
- Effects from land contamination on human health, surface water and groundwater.

10.12.3. Effects on bedrock geology and superficial deposits, including geological designations and sensitive / valuable non-designated features have been scoped out of the assessment as there are no Local Geological Sites or geological SSSIs located within the study area. Soils of other importance have also been scoped out of the soils and agricultural land assessment.

11. Cultural Heritage

11.1. Introduction

11.1.1. This chapter provides the environmental scoping assessment of the Scheme for cultural heritage. The chapter identifies the study area for assessment of the historic environment, including a review of the known heritage assets within the study area, and presents the proposed scope and methodology for the the Cultural Heritage chapter of the ES for the Scheme.

11.1.2. It also identifies those potential effects on cultural heritage likely to be incurred during construction and operation, providing evidence for any aspects of the historic environment that will be scoped out of further assessment.

11.1.3. The historic environment baseline outlined in this chapter has been informed using data from the National Heritage List for England (NHLE) and Gloucestershire Historic Environment Records (GHER). Other sources for information on the baseline historic environment are identified as part of the scope of assessment, to be included in the ES.

11.1.4. No site visit has taken place to inform this chapter, due to the restrictions relating to the COVID-19 pandemic. However, a site visit is not considered necessary to inform the scoping report for the ES, though it will be undertaken as part of later assessments.

11.2. Study area

11.2.1. The study area includes the proposed work at the M5 Junction 10, the A4019 into Cheltenham, and the Link Road. To capture the potential indirect impacts on high-value assets through changes in setting, the study area for designated assets is wider than that for non-designated assets, as follows:

- The Scheme footprint plus a 500m buffer for non-designated heritage assets, to identify impacts and characterise the historic environment to aid in option selection; and
- The option alignments plus a 1 km buffer for designated heritage assets[92] to also incorporate possible indirect impacts such as those on setting and landscape.

11.2.2. As the EIA process continues, it may be possible to further refine the study areas based on new information. This may include information such as the Zone of Theoretical Visibility provided by Landscape and Visual Impact Assessments (LVIA). It will also include a more refined and comprehensive understanding of the historic environment, gained by further assessments and by archaeological investigations, assessments of significance, and setting assessments.

11.3. Planning policy and topic legislative context

11.3.1. The following legislation, national planning policies and guidance are applicable to the Scheme:

- National Policy Statement for National Networks (NN NPS) 2014;
  - The Scheme falls within the definition of an NSIP, making the NN NPS the primary planning policy against which an application for a DCO for the Scheme would be judged;
- National Planning Policy Framework (NPPF) 2019;
  - Given that the Scheme is an NSIP, the NPPF has the status of a material consideration in planning terms.
- National Planning Practice Guidance (NPPG) 2019;

[92] Includes listed buildings, Scheduled Monuments, registered parks and gardens, registered battlefields, conservation areas, and World Heritage Sites.

- The Infrastructure Planning (Decisions) Regulations 2010;
- Ancient Monuments and Archaeological Areas Act 1979; and
- Planning (Listed Buildings and Conservation Areas) Act 1990.

11.3.2. Local planning policy has the status of a material consideration for the Scheme and includes:

- The JCS Policy SD8 “Historic Environment”
- The Cheltenham Plan (2018 draft) policies:
- HE1: Buildings of Local Importance and Non-designated Heritage Assets
- HE2: National and Local Archaeological Remains of Importance

11.4. Baseline conditions

11.4.1. The following baseline consists of the known heritage assets within the study area. An abbreviated gazetteer of known heritage assets is included in Appendix B, and a complete gazetteer will be included in the ES. A map of the options, showing study areas and heritage assets, is provided in Appendix B.

Designated heritage assets

11.4.2. A total of 31 designated heritage assets are recorded within the study area. These include one scheduled monument (Moat House Moated Site [1016835]), one Grade I listed building (the Church of St Mary Magdalene, Boddington [1172312]) and 29 Grade II listed buildings. Three groups of designated assets stand out as having the potential for being receptors affected by significant impacts from the Scheme:

- The Scheduled Monument (1016835) and four Grade II listed buildings (1091874, 1154528, 1303797, and 1340069) located at Moat House, c. 100 m south of the A4019 at Moat Lane;
- Two Grade II listed buildings (1091875 and 1303770) c. 160 m north of the A4019 near the Uckington & Elmstone Hardwicke Village Hall; and
- Two Grade II listed buildings (1088722 and 1305182), c 200 m west of the new link road between the B4634 and the A4019 and associated with archaeological remains of Withybridge Mill (GHER 6474).

Non-designated heritage assets

11.4.3. The study area includes a variety of known archaeological remains relating to prehistoric and historic use of the region. Cropmarks recorded in the study area are suggestive of prehistoric settlement, and excavations at All Saints Academy, near the eastern end of the Scheme, confirmed activity dating to the middle Bronze Age. Unsurprisingly for the area around Cheltenham, Romano-British archaeological remains are found throughout the study area, including settlements and field systems. An area of cropmarks thought to relate to a later prehistoric or Romano-British field system (GHER 8637) is recorded in the field south of the A4019, where the link road to the B4634 is proposed.

11.4.4. Early medieval remains have been identified through archaeological excavations near All Saints Academy. Cropmarks and earthworks of possible shrunken medieval settlements attest to later medieval settlement, along with the scheduled monument at Moat House, and other moated sites (not scheduled), in the study area. Structures and archaeological remains associated with medieval and post-medieval mills are recorded along the River Chelt. Post-medieval turnpikes and associated structures, as well as other built heritage assets, are seen throughout the study area. More recent heritage is seen in sites related to World War II defences of the area.

11.4.5. The ES will include assessments to characterise and evaluate the known and potential for unknown non-designated heritage assets. The underlying geology of the area includes Cheltenham Sand and Gravels, which is known to correlate with prehistoric and Romano-British settlement patterns. As there is a good potential for as-yet unknown archaeological remains to be impacted by the Scheme, a geophysical survey for archaeological remains

will be undertaken as part of the assessments, to further understand potential impacts along the corridor proposed for the A4019/B4634 link road.

Historic Landscape

11.4.6. Historic Landscape Characterisation (HLC) has been completed for Gloucestershire and is included in the scope for assessment of the historic environment. HLC information can be used to identify contributions of setting to the significance of heritage assets, as well as assisting in the development of sympathetic development within the rural landscape. In addition to the HLC for the area, the HER also includes data from the National Mapping Programme (NMP) that indicates strong survival of historic landscape features such as ridge and furrow, earthworks associated with historic settlements and industry, and cropmarks indicative of prehistoric or Romano-British archaeological remains.

11.5. Assumptions and limitations

11.5.1. The following assumptions have been made in the preparation of this Scoping Report:

- Data from the GHER, obtained for PCF Stage 2 work, is sufficient for scoping activities that will be required for PCF Stage 3; and
- Specific impacts and mitigation measures cannot be fully identified at the scoping level, and further PCF Stage 3 assessments may expand or limit the study areas identified in this document.

11.5.2. Limitations to the PCF Stage 3 scoping activities have included:

- No site visit was undertaken of the option study areas to ascertain the condition of any known assets or their settings;
- Baseline data gathering was limited to online searches due to archival access restrictions as a result of the COVID-19 pandemic; and
- Geophysical surveys undertaken during PCF Stage 2 were not completed in time to be included in this scoping report, but will inform assessments at PCF Stage 3.

11.5.3. It is anticipated that the activities listed above will be conducted during the assessment phase and feed into the ES.

11.6. Potential impacts

11.6.1. The potential impacts of construction include both potential physical effects upon heritage assets, and potential non-physical effects resulting from alteration to the 'setting' of heritage assets. Physical impacts as a result of construction can include full removal of below ground remains, changes to Designated Assets and to Conservation Areas. Non-physical effects constitute indirect changes to the value of assets through changes to settings.

11.6.2. The Scheme has the potential to impact known archaeological remains at GHER 8637 and are likely to also have direct physical impacts on as-yet unknown archaeological remains.

11.7. Potential effects and mitigation measures

11.7.1. Due to the scale of the Scheme and the necessary ground disturbance that would be required, all potential effects have been scoped into the EIA assessment, including effects from direct and indirect impact as well as temporary and permanent impacts.

11.7.2. Mitigation measures will be identified based on specific impacts identified during the EIA assessment.

11.7.3. These may include changes in design or landscaping to lessen visual impacts on the settings of high-value heritage assets or to avoid high-value archaeological remains.

11.7.4. As direct physical impacts to known archaeological remains are elements common to all options being assessed (as well as the potential to impact as-yet unknown remains), an

Archaeological Management Plan is recommended to be prepared to provide an over-arching plan for identifying and addressing archaeological impacts.

11.8. Likely residual effects

11.8.1. Residual effects are those likely to remain after all mitigation measures have been implemented. As construction activities will destroy archaeological remains through permanent removal, programmes of excavation and recording are generally carried out to "mitigate" the impact. There can never be 100% recovery of all the information contained within an archaeological site, however, which results in a slight adverse residual effect overall. Mitigation measures designed to eliminate or limit the impacts to settings of heritage assets are recommended to ensure an overall slight adverse or neutral residual effect at minimum.

11.9. Proposed level and scope of assessment

11.9.1. All aspects of the historic environment, comprising buried remains, monuments, the built historic environment and historic landscapes, will be scoped in and will be covered within the Cultural Heritage Chapter. This includes designated heritage assets such as scheduled monuments, listed buildings, registered parks and gardens, registered battlefields and conservation areas, as well as non-designated heritage assets identified through the Gloucestershire Historic Environment Record. The assessment will also include an assessment of the potential for as-yet unknown archaeological remains.

11.10. Proposed assessment methodology

11.10.1. To ensure standards appropriate for work within the strategic road network, assessment of the historic environment will follow the guidelines of the DMRB (2019). Within the DMRB, *LA104: Environmental Assessment and Monitoring* provides guidance on the assessment of the value (sensitivity) of receptors, as well as the assessments of magnitude of impact and determination of significance of effect.

11.10.2. The treatment of Cultural Heritage is further discussed in *LA106: Cultural Heritage Assessment*, which outlines the methodology specific to heritage. In contrast to the previous guidance in HA208/07, LA106 no longer divides the Cultural Heritage resource into archaeological remains, historic buildings and historic landscape, nor does it provide any prescriptive determination of value (sensitivity) based on designation. The applicability of the guidance provided in HA208/07 has long made it a standard for assessing value and significance in the historic environment, including outside the realm of highways schemes. As such, some of the detail of the methodologies in HA208/07 have been used to provide exemplars to assist in the understanding of how the LA104 guidance has been applied to the assessment of Cultural Heritage.

11.10.3. In addition, the following professional standards and guidance will be used to undertake the assessment of the historic environment:

- Standards and guidance for archaeological evaluations and watching briefs: Chartered Institute for Archaeologists (CIfA) (2014);
- Standards and guidance for archaeological desk-based assessment: Chartered Institute for Archaeologists (CIfA) (2014, revised 2017);
- The Setting of Heritage Assets Historic Environment Good Practice Advice in Planning: 3 (2nd Edition), Historic England (2017);
- Managing Significance in Decision-Taking in the Historic Environment - Historic Environment Good Practice Advice in Planning: 2, Historic England (2015); and
- Conservation Principles, Policies and Guidance for the Sustainable Management of the Historic Environment, English Heritage (2008), and Conservation Principles for the Sustainable Management of the Historic Environment Consultation Draft, Historic England (2017).

11.10.4. The first step in environmental assessment is in understanding the value or sensitivity of environmental receptors. For Cultural Heritage, the receptors are defined as heritage assets[93]. The value of a heritage asset is defined by its heritage interest and ability to contribute to local, regional, national and/or international research agendas and frameworks. The guidance provided by LA104 lays out the requirements for assessment, as noted in the descriptions of values are laid out as shown in Table 11-1. The examples for Cultural Heritage proposed for use by the EIA are provided as well, based on industry standards and professional judgement.

Table 11-1 - The Value (Sensitivity) of Heritage Assets

Value (Sensitivity)	Description (LA104)	Example
Very High	Very high importance and rarity, international scale and very limited potential for substitution.	Internationally significant heritage assets such as World Heritage Sites, or buildings recognised as being of international importance.
High	High importance and rarity, national scale, and limited potential for substitution.	Nationally important heritage assets generally recognised through designation as being of exceptional interest and value. Grade I and II* Listed Buildings, Grade I and II* Registered Parks and Gardens, Scheduled Monuments, Protected Wreck Sites, Registered Historic Battlefields, Conservation Areas with notable concentrations of heritage assets and non-designated assets of national or international importance.
Medium	Medium or high importance and rarity, regional scale, limited potential for substitution.	Regionally important heritage assets recognised as being of special interest, generally designated. Grade II Listed Buildings, Grade II Registered Parks and Gardens, Conservation Areas and non-designated assets of regional or national importance, including archaeological remains, which relate to regional research objectives or can provide important information relating to particular historic events or trends that are of importance to the region.
Low	Low or medium importance and rarity, local scale.	Assets that are of interest at a local level primarily for the contribution to the local historic environment. Non-designated heritage assets such as locally listed buildings, non-designated archaeological sites, non-designated historic parks and gardens etc. Can also include degraded designated assets that no longer warrant designation.
Negligible	Very low importance and rarity, local scale.	Non-designated features with very limited or no historic interest. Can also include highly degraded designated assets that no longer warrant designation.
Unknown	The importance of an asset has not been ascertained.	

11.10.5. Following an assessment of the value (sensitivity) of the heritage receptors, the magnitude of impact of the proposed development is considered. The types of impacts that may occur are discussed in Section 11.6, and Table 11-2 shows how this is considered against the value (sensitivity) of the heritage receptors.

[93] A building, monument, site, place, area or landscape identified as having a degree of significance meriting consideration in planning decisions, because of its heritage interest (NPPF 2018 glossary).

11.10.6. The significance of effect on the Cultural Heritage resource is determined by consideration of a combination of the magnitude of the impact and the value of each asset, with a level of professional judgement included in the determination. The matrix by which significance of effect is determined is demonstrated in Table 4-1.

Table 11-2 - Assessing the Magnitude of Impact

Magnitude of impact		Example
Major	Adverse	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements. For example, this could include: major changes that remove or alter elements of high significance; notable alterations to the setting of an asset that affect our appreciation of it and its significance; or the unrecord loss of archaeological interest
	Beneficial	Large scale or major improvement of resource quality; extensive restoration; major improvement of attribute quality.
Moderate	Adverse	Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements. For example, this could include: physical alterations that remove or alter some elements of significance, but do not substantially alter the overall significance of the asset; notable alterations to the setting of an asset that affect our appreciation of it and its significance; or the unrecorded loss of archaeological interest.
	Beneficial	Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality.
Minor	Adverse	Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements. For example, this could include: physical changes that alter some elements of significance but do not noticeably alter the overall significance of the asset; and small-scale alterations to the setting of an asset that hardly affect its significance.
	Beneficial	Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring.
Negligible	Adverse	Very minor loss or detrimental alteration to one or more characteristics, features or elements.
	Beneficial	Very minor benefit to or positive addition of one or more characteristics, features or elements.
No change/neutral		No loss or alteration of characteristics, features or elements; no observable impact in either direction

11.10.7. Where two potential values of significance of effect are identified in DMRB, professional judgement will be used to assign the value, based on understanding of details of both the magnitude of impact and value of the asset.

11.10.8. The determination of what constitutes ‘harm’ in terms of the Infrastructure Planning (EIA) Regulations (2017) is assessed on an individual basis; moderate to very large adverse or beneficial effects are generally considered to be ‘significant’ in terms of these regulations. The significance of the effect may be lessened through mitigation measures in design of by off-setting of impact.

11.11. Proposed consultation

11.11.1. Statutory consultees for this assessment include Historic England and Gloucestershire County Council. It is recommended that consultation begins at an early stage, to ensure effective communication between the parties and develop a comprehensive baseline for assessment. Early consultation will also allow for consideration of stakeholder input into possible design measures, to ensure the potential for significant impacts is identified at an early stage and mitigated where possible through design.

11.12. Conclusion

11.12.1. Initial reviews of the baseline data conclude that all aspects of the historic environment should be scoped into EIA assessment: designated and non-designated known heritage assets, the potential for as-yet unknown archaeological remains, built heritage, and historic landscape.

11.12.2. Direct physical impacts will be assessed, as well as potential indirect impacts to the significance of heritage assets through changes in setting. The options being considered all have the potential to impact known and as-yet unknown archaeological remains. Further work will be required to identify, characterise, and evaluate the impacts to these assets.

12. Materials and Waste

12.1. Introduction

12.1.1. This chapter provides the environmental scoping assessment of the Scheme for materials and waste. The chapter outlines the methodology that will be used to identify and assess the likely impacts from using material assets and waste generation associated with the Scheme, during construction, demolition and excavation (CD&E) and operation. The chapter has been written in accordance with the Highways England document LA 110 Material Assets and Waste (formerly IAN 153/11).

12.1.2. Material assets are defined as “the materials and construction products required for the construction, improvement and maintenance of the trunk road network. Material assets include primary raw materials such as aggregates and minerals, and manufactured construction products. Many material assets will originate off site, purchased as construction products, and some will arise on site such as excavated soils or recycled road planings.”

12.1.3. Waste is defined as per the Waste Framework Directive (2008/98/EC) as “any substance or object which the holder discards or intends or is required to discard."

12.2. Study area

12.2.1. Two study areas have been defined for the assessment, as per DMRB LA 110. These are:

- The Scheme boundary, where material assets will be consumed (used, reused and recycled) and waste will be generated; and
- The area for the management of waste.

12.2.2. Based on the Highways England guidance this second area will be the South-West region of England.

12.3. Planning policy and topic legislative context

12.3.1. A summary of legislative requirements and relevant planning policy, strategu and guidance in relation to material assets and waste and how they apply to the Scheme is presented below.

12.3.2. Many of the relevant UK acts and regulations relating to waste incorporate European Union (EU) directives into UK Law. These include:

- EU Revised Waste Framework Directive (2008/98/EC)
- EU Landfill Directive (1993/31/EC), as amended by the EU Directive (2003/33/EC)
- EU Regulation 1272/2008 on classification, labelling and packaging of substances and mixtures (including revisions)

National Policy

National Policy Statement for National Networks (NN NPS, 2014)

12.3.3. The Scheme falls within the definition of an NSIP, making the NN NPS the primary planning policy against which an application for a DCO for the Scheme would be judged.

12.3.4. The NN NPS outlines the importance of managing resources and wastes to prevent and minimise environmental impacts (paragraphs 5.39 to 5.66). Mitigation measures should be adopted and considered throughout all stages of the Scheme. Mitigation measures are inclusive of, but not limited to, the implementation of the waste hierarchy, the correct management of waste both on-site and off-site and identifying the appropriate waste infrastructure for waste treatment and disposal.

National Planning Policy for Waste 2014

12.3.5. The National Planning Policy for Waste follows the principles set out in Planning Policy Statement 10 (PPS10), which states that waste should be managed in line with the principles of the waste hierarchy. It is important to ensure that, where possible, waste production is minimised to reduce environmental impacts and to ensure an assessment is made of the local waste infrastructure type and capacities, to include, but not be limited to, an assessment of the local policies.

National Planning Policy Framework (NPPF)

12.3.6. Given that the Scheme is an NSIP, the NPPF has the status of a material consideration in planning terms.

12.3.7. As part of the 2019 revision, the NPPF's goal of supporting sustainable development identifies the importance of using natural resources prudently and minimising waste. It identifies that strategic policies should make provision for minerals and waste management. Section 17 focuses on "Facilitating the sustainable use of minerals", and states planning policies should include consideration of the following points:

- Provide for the extraction of mineral resources of local and national importance, except for peat;
- Take account of the contribution that recycled materials and minerals waste can make to supply of materials; and
- Safeguard mineral resources by defining Mineral Safeguarding Areas (MSA).

Resources and Waste Strategy for England 2018

12.3.8. The Strategy sets out national policy for minimising waste, promoting resource efficiency and moving towards a circular economy. The Strategy focuses on the importance of driving waste management up the Waste Hierarchy and states the importance of considering the Government's ambition of achieving zero avoidable waste.

12.3.9. The Strategy is based around two overarching objectives which aim to maximise the value of resource use and to minimise waste and its impact on the environment.

12.3.10. The Strategy puts a strong emphasis on waste prevention through making products using fewer natural resources. The Strategy references the UK statistics on waste which show that over 90% of non-hazardous construction and demolition waste was recovered in 2016.

The Environmental Protection Act 1990

12.3.11. The Act implements integrated pollution control for the disposal of waste to air, land and water, including solid waste disposal.

12.3.12. As part of this, under Section 34, the Act imposes Duty of Care on anyone who produces, imports, keeps, stores, transports, treats or disposes of waste.

12.3.13. This will mean that the applicant and all contractors must take all reasonably practical steps to ensure that:

- Waste is consigned only to a registered waste carrier, licensed waste contractor, local authority waste collector or person dealing with waste in ways that are exempt from licensing;
- Waste that is disposed of is accompanied by a detailed written description of the waste to ensure its safe handling, treatment and disposal (waste transfer notes are to be kept for a minimum of two years and hazardous waste consignment notes are to be kept for a minimum of three years);
- Waste is securely contained to prevent it escaping to the environment;
- Appropriate measures are taken to ensure that others involved in the handling and disposal of waste do so in accordance with all applicable Regulations;
- Copies of registration certificates should be obtained for all waste contractors and waste carriers used as part of the Scheme and it should be ensured that they are

on the Environment Agency's 'Public Register of Waste Carriers, Brokers and Dealers'; and

- Checks should be made on the destination of each waste, ensuring that each waste management facility is licensed to accept the waste. Duty of Care audits of carriers and waste management facilities are advisable.

Clean Neighbourhoods and Environment Act 2005

12.3.14. Chapter 16 of the Act prescribes the correct transportation, collection, disposal and management of waste and prohibits fly tipping.

The Environmental Permitting (England and Wales) Regulations 2016

12.3.15. The Regulations put in place requirements to ensure that sites that produce certain materials and undertake certain activities (such as the storage, use or treatment of waste) have a permit or exemption from the regulator (i.e. the Environment Agency).

12.3.16. Permit or exemption details of all sites that manage waste from the Scheme will be checked to ensure waste is being managed in accordance with all applicable legislation and policies and in accordance with good practice.

Waste (England and Wales) Regulations 2011

12.3.17. The Regulations transpose the Revised EU Waste Framework Directive (2008/98/EC) into law and require organisations to manage waste in accordance with the waste hierarchy, to prevent waste going to landfill.

12.3.18. Waste management contractors working on the Scheme will be required to provide evidence that the waste hierarchy has been applied. This evidence can be in the form of waste transfer notes and hazardous waste consignment notes, which themselves must be kept for two and three years, respectively.

The Hazardous Waste (England and Wales) Regulations 2005

12.3.19. The Regulations transpose the Revised EU Waste Framework Directive (2008/98/EC) into law, providing a definition of hazardous waste and require a hazardous waste consignment note to be produced for movement of hazardous waste.

Waste Electrical and Electronic Equipment (WEEE) Regulations 2013

12.3.20. The Regulations have a key objective to reduce the amount of WEEE that goes to landfill. This is to be achieved by making producers responsible for the collection, treatment and recovery of WEEE, including the associated costs.

12.3.21. For the Scheme, all WEEE produced in the construction, demolition and excavation (CD&E) and operational phases must be segregated and managed separately from other wastes, with relevant paperwork provided as described above.

The Waste Batteries and Accumulators Regulations 2009

12.3.22. The Regulations main requirements are that producers of batteries and accumulators must either take back waste batteries and accumulators or fund the collection and recycling of them.

12.3.23. All batteries produced in the CD&E and operational phases must be segregated and managed separately from other wastes.

12.4. Baseline conditions

12.4.1. The baseline has been established through a desk-based review of regional and national data, based on Highways England guidance, from the following sources (most up to date at time of writng):

- The Mineral Products Industry at a Glance, 2018 Edition[94]
- Environment Agency Landfill Capacity Data, 2020[95]
- Environment Agency Waste Data Interrogator (WDI), 2018[96]

Material Assets Baseline

12.4.2. Highways England guidance states that schemes in the SouthWest region of England should have a minimum baseline of 22% recycled content in materials and components.

12.4.3. Material asset sales for the South West region of England are shown in the table below. These are for the Material Assets most likely to be required for the Scheme.

Table 12-1 - Material Assets Baseline

	South West England (Tonnes)
Crushed rock	25,900,000
Concrete	2,845,200
Asphalt	2,100,000

Mineral Safeguarding Areas

12.4.4. The Gloucestershire Policies Map shows the Scheme will go through Mineral Consultation/Safeguarded Areas.

Peat Reserves

12.4.5. Sources[97,98,99] show there are no Blanket Bogs, Lowland Fens or Lowland Raised Bogs areas along the Scheme. Therefore, there are no areas that are / could give rise to peat reserves.

Landfill Capacity and Waste Infrastructure Baseline

12.4.6. Construction, demolition and excavation (CD&E) waste generated by the Scheme will predominantly be non-hazardous and inert, with small quantities of hazardous waste (e.g. paints, solvents and contaminated soil).

12.4.7. The baseline for landfill capacity and waste infrastructure for the South West was calculated using Environment Agency Data.

Table 12-2 - Landfill Capacity Baseline

Waste Stream	South West England (m^3)
Inert and non-hazardous	25,775,530
Hazardous	1,692,122

Table 12-3 - Waste Infrastructure Capacity Baseline

Waste Stream	South West England (tonnes)
Inert and non-hazardous	5,400,982
Hazardous	35,540

[94] Mineral Products Association: Profile of the UK Mineral Products Industry (2018)
[95] Environment Agency 2018 Remaining Landfill Capacity – Version 2 (2018)
[96] Environment Agency Waste Data Interrogator (2018)
[97] http://magic.defra.gov.uk/
[98] http://www.landis.org.uk/soilscapes/
[99] http://mapapps.bgs.ac.uk/geologyofbritain/home.html

12.5. Assumptions and limitations

12.5.1. Several assumptions are applicable to the proposed assessment methodology, as outlined below:

- Industry standard thickness of road layers will be used to determine material use volumes;
- All material and waste quantities will be converted into tonnes/m^3 using industry standard conversion rates; and
- All material assets will be grouped according to main material types.

12.5.2. The key limitation to the proposed assessment methodology is the availability of data within the timeframes of the ES.

12.5.3. Every effort will be made to base the assessment on Scheme's specific information but in some cases information from previous, similar projects or industry baselines (i.e. for recycled content) may need to be used.

12.6. Potential impacts

Construction

12.6.1. The Scheme would likely result in two main impacts from construction, these are:

- The use of material assets, likely to be aggregate and asphalt. Smaller quantities of materials that would be used include concrete, metal and wood amongst others; and
- The generation of waste. Key waste streams are likely to be soil, aggregate, asphalt and concrete. Smaller quantities of wastes that would be generated include metal, wood and vegetation, as well as municipal waste and septic tank waste from the workforce.

Operation

12.6.2. Minimal impact is envisaged during the operation stage of the Scheme due to limited material assets use (mostly associated with planned/ unplanned maintenance) and waste generation. Most of the wastes would likely be non-hazardous municipal type wastes (e.g. litter) and non-hazardous/ inert and hazardous wastes from planned/ unplanned maintenance (e.g. concrete, bituminous materials, WEEE, oils, etc.).

12.6.3. Due to the minimal impact anticipated, material assets use and waste generation, during operation, has been scoped out of the assessment (as described in Section 12.12).

12.7. Potential effects and mitigation measures

Potential Effetcs

12.7.1. The potential effect of material asset use is the permanent removal of these material assets from the market which may limit availability of these material assets to other projects.

12.7.2. The potential effect of waste generation is the temporary use of waste infrastructure to manage and process the waste and the permanent use of landfill void space. These effects could both limit the ability of other projects to manage and dispose of their waste.

12.7.3. As part of the ES the actual quantities of material assets used, and waste generated will be assessed against the baselines to quantify these effects.

Potential Mitigation Measures

12.7.4. Although every effort will be made (through the design process) to maximise resource efficiency, it is inevitable that material assets will be used, and waste will be generated by

the Scheme. This will have an impact on material assets availability and waste infrastructure capacity.

12.7.5. The design of the Scheme will ensure that material assets use, and wastage is minimised throughout its lifecycle. During the design stage, the potential effects can be addressed using the following mitigation measures which will then follow through to the construction stage:

- Management of waste within the context of the waste hierarchy;
- Management of waste in accordance with local and national policy and legislation and, where applicable, guidance documents;
- Safe management of the waste generated, as determined by its physical and chemical characteristics (e.g. bulky or hazardous wastes);
- Minimise potential environmental effects or human health risks associated with waste arisings throughout the lifecycle of the Scheme; and
- Use of material assets and the management of waste in accordance with the Proximity Principle, which promotes the procurement of material assets and management of wastes as locally as possible.

12.7.6. The overall aim of the process of identifying mitigation measures is to achieve a high reduction, reuse, recycling and recovery rate of wastes from the Scheme. Achieving this will minimise environmental burdens in terms of:

- Impacts to the environment and human health;
- Energy and carbon impacts;
- The overall sustainability of the Scheme; and
- Reduce costs associated with excessive material procurement and waste storage, collection, management and disposal.

12.8. Likely residual effects

12.8.1. At this stage, resdidual effects are the same as potential effects until actual quantities of material assets and waste generated are known and the mitigation measures can be applied to those.

12.9. Proposed level and scope of assessment

12.9.1. The following tasks are proposed to determine the impact of material assets use and waste generation from the Scheme:

- Review proposed construction quantities and types of material assets and wastes;
- Identify and evaluate the impacts of the Scheme against the baselines identified in Section 12.4;
- Identify opportunities to mitigate material assets impacts such as replace virgin/raw materials with recycled materials / materials with recycled content and maximise the use of renewable material assets over the use of non-renewable material assets wherever feasible; and
- Identify opportunities to mitigate waste impacts to reduce, re-use, recycle and/or recover wastes via a review of the Scheme and in accordance with industry best practice.

12.9.2. Whilst not mandatory, it is best practice to produce a Site Waste Management Plan (SWMP) as part of the mitigation. The SWMP should be maintained as a live document throughout the Scheme development. It should include the anticipated types and quantities of waste generated on site and actions undertaken to minimise waste generation.

12.10. Proposed assessment methodology

12.10.1. The methodology and criteria described in DMRB LA 110 will be applied to determine the significance of effects associated with material assets and waste during the construction stage of the Scheme.

12.10.2. The magnitude of the anticipated material assets used, and waste generated by the Scheme will be determined by assessing the emerging design detail.

Assessment Criteria

12.10.3. The impact of the Scheme on material assets and waste generation will be calculated by establishing the significance of the impact; this will be achieved by assessing the level of environmental effect. Table 12-4 below summarises how the effects will be defined.

Table 12-4 - Criteria for Classifying the Environmental Effects

Significance Category	Description
Very Large	Material Assets 1) no criteria: use criteria for large categories. Waste 1) >1% reduction or alteration in national capacity of landfill, as a result of accommodating waste from a project; or 2) construction of new (permanent) waste infrastructure is required to accommodate waste from a project.
Large	Material Assets 1) project achieves <70% overall material recovery / recycling (by weight) of non-hazardous Construction and Demolition Waste (CDW) to substitute use of primary materials; and 2) aggregates required to be imported to site comprise <1% re-used / recycled content; and 3) project sterilises ≥1 mineral safeguarding site and/or peat resource. Waste 1) >1% reduction in the regional capacity of landfill as a result of accommodating waste from a project; and 2) >50% of project waste for disposal outside of the region.
Moderate	Material Assets 1) project achieves less than 70% overall material recovery / recycling (by weight) of non-hazardous CDW to substitute use of primary materials; and 2) aggregates required to be imported to site comprise re-used/recycled content below the relevant regional percentage target. Waste 1) >1% reduction or alteration in the regional capacity of landfill as a result of accommodating waste from a project; and 2) 1-50% of project waste for disposal outside of the region.
Slight	Material Assets 1) project achieves 70-99% overall material recovery / recycling (by weight) of non-hazardous CDW to substitute use of primary materials; and 2) aggregates required to be imported to site comprise re-used/recycled content in line with the relevant regional percentage target.

	Waste 1) ≤1% reduction or alteration in the regional capacity of landfill; and 2) waste infrastructure has sufficient capacity to accommodate waste from a project, without compromising integrity of the receiving infrastructure (design life or capacity) within the region.
Neutral	Material Assets 1) project achieves >99% overall material recovery / recycling (by weight) of non-hazardous Construction Demolition Waste (CDW) to substitute use of primary materials; and 2) aggregates required to be imported to site comprise >99% re-used / recycled content. Waste 1) no reduction or alteration in the capacity of waste infrastructure within the region.

12.10.4. Table 12-4 defines 'neutral' to 'very large' environmental effects for both material assets and waste which are combined to determine the Scheme's significance level as shown in Table 12-5 below. The Scheme can then be defined as significant or not significant.

Table 12-5 - Significance Criteria for Material Assets and Waste

Significance	Description
Significant (one or more criteria met)	Material Assets: 1) category description met for moderate or large effect. Waste: 1) category description met for moderate, large or very large effect.
Not significant	Material Assets: 1) category description met for neutral or slight effect. Waste: 1) category description met for neutral or slight effect

12.11. Proposed consultation

12.11.1. It is proposed that Gloucestershire County Council, as the author/owner of the Gloucestershire Waste Local Plan and Gloucestershire Waste Core Strategy will be consulted on the proposed assessment methodology.

12.12. Conclusion

12.12.1. An assessment of the impacts from material asset use and waste generation will be made in accordance with DMRB LA 110 Material Assets and Waste.

12.12.2. Based on that document the study area will be the Scheme boundary for material assets and the South West region of England for waste.

12.12.3. Table 12-6 contains a summary of what will be scoped in and out for material assets and waste for the ES.

Table 12-6 - Topics Scoped In and Out of Further Assessment

Effects	Scoped in/out	Comment/Justification
Change in demand for material assets during the CD&E stage.	In	Assessment required to evaluate the impacts of the Scheme against the sales of material assets during the CD&E stage.
Change in demand for material assets during the operation stage.	Out	Operational demand for material assets from the Scheme will not be assessed as it is envisaged that this will be minimal.
Change in capacity of waste infrastructure during the CD&E stage.	In	Assessment required to evaluate the impacts of waste arisings from the Scheme against the regional waste infrastructure baseline during the CD&E stage.
Change in capacity of waste infrastructure during the operation stage.	Out	Operational waste arisings from the Scheme will not be assessed as it is envisaged that this will be minimal.

13. Population and Human Health

13.1. Introduction

13.1.1. This chapter provides the environmental scoping assessment of the Scheme for Population and Human Health.

13.1.2. The Infrastructure Planning (EIA) Regulations 2017, specifically Regulation 5(2), requires Environmental Statements to include, inter alia, assessment of potential effects upon population and human health. This chapter has been prepared in accordance with best practice, professional judgement, and DMRB LA 112[100]. The Population and Human Health assessment will ascertain the likely positive and negative effects of the construction and operation of the Scheme, and opportunities for improving health and reducing inequalities.

13.1.3. The chapter opens with an overview of the study area for the preferred option, as well as an overview of the key planning policy that informs the decision making regarding this chapter. The chapter provides an introduction to the general methodology for collating baseline information, identifying impacts and assessing potential effects at this scoping stage. It also highlights aspects of the methodology that will require further development as the Scheme progresses to the ES assessment stage in the EIA process.

13.1.4. The chapter includes an assessment of the effect of the preferred option on agricultural land holdings and associated infrastructure, but not agricultural soils and land quality, which are assessed in Chapter 10 (Geology and Soils).

13.1.5. The limitations to this scoping assessment are noted, together with the proposed scope for further desk-based study and site surveys, as required.

13.1.6. The chapter provides a description of the known baseline characteristics of the Population and Human Health environment, drawing on desk-based data sources. An initial review of the likely impacts of Scheme has been completed and this has been compared to the baseline in order to identify potential environmental effects arising from the Scheme. This report also indicates, where possible, the likely significance or otherwise of the effects identified.

13.2. Study area

13.2.1. The study area for this scoping assessment has been set according to:

- The extent and characteristics of the Scheme; and
- The location (in relation to the Scheme), characteristics and sensitivity of communities and associated facilities / amenities.

13.2.2. The study area falls within the local authority areas of TBC and CBC.

13.2.3. DMRB guidance for Population assessment requires the study area to be based on the construction footprint / Scheme boundary. This requires the assessment to include compounds and temporary land, plus a 500 m area surrounding the Scheme boundary. These elements of the construction for the Scheme are yet to be fully developed, therefore the Population assessment has explored a study area of 500 m from the currently known Scheme boundary. It should be noted that the methodology also allows some flexibility within this to extend or redact the 500 m area depending on the sensitivity of receptors identified within it.

13.2.4. For the agricultural component of this assessment the study area is the entirety of the farm holdings crossed by the consolidated study area for the Scheme.

13.2.5. At the next stage of the EIA process, these study areas will take account of the temporary land take required during the construction phase.

[100] https://www.standardsforhighways.co.uk/dmrb/search/1e13d6ac-755e-4d60-9735-f976bf64580a

13.2.6. For Human Health, the study area is required by DMRB guidance to encompass the communities and wards that are directly or indirectly affected by the Scheme. The selection of wards is informed by the extent and characteristics of the Scheme.

13.2.7. Effects within the Human Health assessment are largely derived from changes in wider health determinants largely selected from the other technical assessments. Consequently, the study areas defined in each contributing technical chapter also apply, allowing for variations due to the absence of construction phase land take proposals. For the next stage of the EIA, these study areas will include:

- Air Quality – for construction, within 200 m of the construction site boundary to assess potential effects of construction dust; for operation, human health receptors identified within 200 m of the ARN;
- Noise and Vibration – for construction, within 300 m of any construction works; for operation, within 1 km of any new or altered routes and 600 m from any affected roads within the study area;
- Landscape – for construction and operation, 1 km from the Scheme boundary;
- Geology and Soils – for construction and operation, for the assessment of agricultural land and agricultural holdings, for the entirety of the agricultural land which is crossed; and
- Road Drainage and the Water Environment – for construction and operation, features of the water environment within 1 km of the Scheme.

13.3. Planning policy and topic legislative context

13.3.1. There is no specific legislation or planning policy relating to the Population and Human Health assessment; however, national and local policy provides direction on relevant issues, particularly transport and land use.

National policy

National Policy Statement for National Networks (NN NPS, 2014)

13.3.2. The NN NPS is directly relevant to highway infrastructure projects on the national road network that are defined as NSIP. The Scheme falls within the definition of an NSIP, making the NN NPS the primary planning policy against which an application for a DCO for the Scheme would be judged.

13.3.3. Paragraph 2.23 sets out the Government's vision and strategic objectives for the national networks, which include improving overall quality of life, journey quality, reliability and safety and linking up communities. Junction improvement is cited as a measure that will be used to enhance the existing national road network towards this vision.

13.3.4. Paragraph 3.3 establishes the expectation that delivery of new schemes will improve quality of life and avoid and mitigate environmental and social impacts in line with the principles set out in the NPPF and the Government's planning guidance. Furthermore, paragraph 3.19 states that schemes will be expected to improve accessibility and inclusivity and reduce community severance, to contribute to a network that provides a range of opportunities and choices for people to connect with jobs, services and friends and family.

13.3.5. Access to high quality open spaces, PRoW, the countryside and opportunities for sport and recreation can be a means of providing mitigation and/or compensation requirements for developments (Paragraphs 5.162 and 5.184).

National Planning Policy Framework (NPPF, 2019)

13.3.6. The NPPF establishes national planning policy to achieve sustainable development, through themes that include promoting sustainable transport, supporting a prosperous rural economy and promoting healthy communities, with a presumption in favour of sustainable development. Given that the Scheme is an NSIP, the NPPF has the status of a material consideration in planning terms.

13.3.7. Paragraph 80 states that planning decisions should help create the conditions in which *'businesses can invest, expand and adapt.'* Furthermore, planning policies and decisions should aim to achieve healthy, inclusive and safe places that:

- promote social interaction;
- are safe and accessible; and
- enable and support healthy lifestyles.

13.3.8. Paragraph 97 recognises that access to a network of high-quality open spaces and opportunities for sport and physical activity is important for the health and well-being of communities. As such, *'existing open space, sports and recreational buildings and land, including playing fields, should not be built on.'*

13.3.9. Paragraph 110 encourages walking, cycling and public transport use. Applications for development should, inter alia:

- 'give priority first to pedestrian and cycle movements, both within the Scheme and with neighbouring areas;'
- 'address the needs of people with disabilities and reduced mobility in relation to all modes of transport;' and
- 'create places that are safe, secure and attractive – which minimise the scope for conflicts between pedestrians, cyclists and vehicles.

Countryside and Rights of Way Act 2000

13.3.10. The Countryside and Rights of Way Act 2000 (CRoW) regulates all PRoW and ensures access to them. It requires local highway authorities to publish a Rights of Way Improvement Plan (RoWIP), which should be reviewed every 10 years. CRoW also obliges the highway authority to recognise the needs of the mobility impaired when undertaking improvements.

Local policy

Gloucestershire Local Transport Plan (LTP) (2020-2041)

13.3.11. The Gloucestershire Local Transport Plan sets the strategic transport vision for the county to 2041. The plan sets out the overarching and mode policies that support the spatial Connecting Places Strategies (CPS) and the Transport Scenarios, looking to 2041. It is a material consideration for the Scheme, given its status as an NSIP.

13.3.12. Paragraph 2.3.1 states that Gloucestershire's vision for transport is 'a resilient transport network that enables sustainable economic growth by providing travel choices for all, making Gloucestershire a better place to live, work and visit.' Paragraph 2.3.4 goes on to state that a key objective of the LTP is to 'improve community health and wellbeing and promote equality of opportunity.'

13.3.13. Policy LTP PD 0.5 Community Health and Wellbeing ensures that people from all social and economic groups and those with disabilities are encouraged to use safe and affordable multi-modal travel options. Furthermore, there is a focus on *'improving air quality; and connecting people to services, employment, housing, education, health services, social and leisure amenities to allow equality of opportunity to health, social and economic wellbeing and remove barriers that can create social isolation.'*

13.3.14. Policy LTP PD 4.4 – Road Safety pledges to 'contribute to improved safety, security and health by reducing the risk of death, injury or illness arising from transport, working with partners to improve personal safety perceptions and the promotion of transport that contributes to good health and wellbeing.'

13.3.15. Policy LTP PD 6.1 – Gloucestershire's Pedestrian Network states that 'GCC will work with interested parties to provide an inclusive safe, reliable and efficient highway environment that encourages walking, and provides pedestrian links to connect communities, employment and services.'

13.3.16. Policy LTP PD 6.2 - Rights of Way ensures that GCC will 'support the Rights of Way and Countryside Access Improvement Plan in identifying and seeking to support measures to improve safety, accessibility and the quality of the experience for walkers, horse riders, carriage drivers and those travelling by bicycle.'

13.3.17. Policy LTP PD 6.4 - Pedestrian Safety states that 'GCC will contribute towards improved safety, security and health by reducing the risk of death, injury or illness arising from journeys on foot or by mobility mode.'

Joint Core Strategy (JCS) 2011-2031

13.3.18. The Joint Core Strategy is a partnership between Gloucester City Council, Cheltenham Borough Council and Tewkesbury Borough Council which will set out a strategic planning framework for the three areas. It is a material consideration for the Scheme, given its status as an NSIP.

13.3.19. The JCS Strategic Objective 1 – 'Building a strong and competitive urban economy' seeks to provide the right conditions and sufficient land in appropriate locations to support existing businesses and attract new ones.

13.3.20. Strategic Objective 7 – 'Promoting sustainable transport' states a preference for improving access to services in rural and urban areas through new development, improved integrated transport links and supporting local and community led transport initiatives.

13.3.21. Relating to Policy SD1: 'Employment – except retail development', paragraph 4.1.12 of the JCS states that there is agreement across relevant partners that the upgrading of M5 Junction 10 to an all movements junction will support the economy of the JCS area and that of wider Gloucestershire.

13.3.22. Policy SD14: 'Health and Environmental Quality' states that new development must result in no unacceptable levels of air, noise, water, light or soil pollution or odour, either alone or cumulatively, with respect to relevant national and EU limit values.

13.3.23. Policy INF1: 'Transport Network' states that developers should provide safe and accessible connections to the transport network to enable travel choice for residents and commuters. Of particular relevance to the Scheme is the notion that proposals should ensure that safe and efficient access to the highway network is provided for all transport modes.

13.3.24. Policy INF6: 'Infrastructure Delivery' states that local planning authorities will seek to secure appropriate infrastructure which is necessary, directly related, and fairly and reasonably related to the scale and kind of the development proposal, including the highway network, traffic management, sustainable transport and disabled peoples' access.

The Cheltenham Plan (July 2020)

13.3.25. The Cheltenham Plan was adopted at a full council meeting of Cheltenham Borough Council on 20 July 2020. It is a material consideration for the Scheme, given its status as an NSIP.

13.3.26. Policy HM3: Loss of Residential Accommodation states that development which involves the loss of residential accommodation through the demolition of existing housing will not be permitted, except where *'the proposed use would be beneficial to the wider economy and the local community.'*

13.3.27. Policy SL1: Safe and Sustainable Living requires new development to avoid 'unacceptable harm to the amenity of adjoining land users'.

Cheltenham Borough Local Plan – Saved Policies (2006)

13.3.28. Policy CP 4: 'Safe and Sustainable Living' states that development should not result in levels of traffic to and from the site attaining an environmentally unacceptable level.

Pre-Submission Tewkesbury Borough Plan 2011 to 2031 (May 2020), plus schedule of changes and updated Proposals Map – composite Submission version

13.3.29. Policy HEA1 Healthy & Active Communities states that major development should be designed in line with 'active design' principles.

13.3.30. Policy COM1 Protecting Community Assets states that where proposals would lead to the loss of existing community assets, there should be no demonstrable current or future need for the asset. Furthermore, all efforts will need to have been made to maintain the asset.

13.3.31. Policy TRAC1 Pedestrian Accessibility outlines the stance that pedestrian networks will be protected across Tewkesbury Borough, as well as extended and enhanced.

13.4. Baseline conditions – Population

13.4.1. This section sets out the key receptors identified during the review of baseline conditions and assigns a level of sensitivity to change for each receptor. The component topics of Population are each divided into subheadings.

Private Property and Housing

13.4.2. Due to the isolated nature of M5 Junction 10, there are few key settlements of note located in and around the study area, with the exception of Cheltenham, which is located directly east of the Scheme. This section of north-west Cheltenham has over 150 dwellings located within the study area. Access to these dwellings from the west is within the Scheme works area. This receptor cluster is therefore of **very high sensitivity to change**.

13.4.3. There are several small settlements in the study area containing a limited number of private dwellings. These settlements include Boddington to the west of the study area, approximately 500 m from the Scheme. There are less than 30 dwellings located here (a threshold quantum within the DMRB LA 112 guidance), and access routes fall outside the Scheme works area. This receptor is therefore of **medium sensitivity to change**.

13.4.4. Uckington is located in the east of the study area, adjacent to the Scheme. There are less than 30 dwellings located here. However, at least three residential properties and one farm building are within the Scheme works area and may be subject to demolition works to allow for the construction of the Scheme. This receptor cluster is therefore of **high sensitivity to change**.

13.4.5. There is a small number of private dwellings in proximity to M5 Junction 10, both to the north-west at Stanboro Lane and adjacent to Sheldon Nurseries; and at Withybridge Gardens, which runs adjacent to the A4019 and the Scheme. There are less than 30 dwellings located here. All 14 of the residential properties at Withybridge Gardens, plus two properties adjacent to the A4019 and three properties at Sheldon Nurseries would be the subject of demolition works to allow for the construction of the Scheme. This receptor cluster is therefore of **high sensitivity to change**.

13.4.6. There is an operational gypsy and traveller site adjacent to the southbound carriageway of the M5, approx. 250 m to the north of the existing M5 Junction 10. There appear to be less than 30 separate caravans within the site curtilage; however, the nature of the use means that occupation levels can change. The vehicular access to the site is from the A4019 to the south, running parallel to the M5 southbound carriageway and is wholly within the Scheme works area. Part of the gypsy and traveller site is also within the Scheme works area. This receptor cluster is therefore of **high sensitivity to change.**

13.4.7. There is a small number of properties located on the B4634, which links the west of Cheltenham to Staverton via Hayden. These are located adjacent to the Scheme. There are less than 30 dwellings located here. However, access to these properties fall within the Scheme works area. This receptor cluster is therefore of **high sensitivity to change**.

13.4.8. A small number of properties is located to the west of Elmstone Hardwicke, to the north of the study area, located approximately 400 m from the Scheme. There are less than 30 dwellings located here, and access routes to these properties fall outside the Scheme works area. This receptor is therefore of **medium sensitivity to change**.

13.4.9. There is also a small number of isolated properties adjacent to the M5 and Withybridge Lane, south of M5 Junction 10, approximately 90 m from the Scheme. There are less than 30 dwellings located here. However, key access routes to these properties fall within the Scheme works area. This receptor cluster is therefore of **high sensitivity to change**.

13.4.10. The following unimplemented residential planning applications and development allocations have been identified within the study area:

- 18/01218/OUT: Outline application for the removal of an agricultural building and the erection of 4 dwellings with all matters reserved except for access;
- 20/00759/FUL: Demolition of a dwelling and the erection of 260 dwellings (Use Class C3), new vehicular and pedestrian access off Manor Road, attenuation basin and ancillary infrastructure;
- Policy A4 – North West Cheltenham: approximately 4,285 new dwellings;
- Policy A7 – West Cheltenham: approximately 1,100 new dwellings; and
- Policy HD8 – Old Gloucester Road: approximately 175 new dwellings.

13.4.11. Application 18/01218/OUT is of **low sensitivity to change** due to the application being for <30 homes on an unallocated site. Application 20/00759/FUL allows for the construction of 260 dwellings and, as this is above the threshold of 150 homes relating to residential development land, it is of **very high sensitivity to change**.

13.4.12. The residential properties included in the land allocated under Policies A4, A7 and HD8 are considered to be of **very high sensitivity to change** due to the extent of the housing allocated. Policies A7 and HD8 are also located adjacent to the Scheme which further increases their sensitivity.

Community land and assets

13.4.13. The study area is predominantly rural in character. As such, the study area benefits from limited amounts of community land and assets. Residents within the study area are considered likely to predomnantly use community land and assets within Cheltenham, to the east of the study area.

13.4.14. Uckington & Elmstone Hardwicke Village Hall is located towards the east of the study area, approximately 140 m from the Scheme. The principal access route passes through the Scheme works area, with limited alternative facilities being available at a local level. This receptor is likely to be used by the majority of the community within which it sits. This receptor is of **medium sensitivity to change**.

13.4.15. The Circle of Light place of worship is located towards the east of the study area at the north of Uckington, approximately 280 m from the Scheme. The principal access route passes through the Scheme works area, with limited alternative facilities being available at a local level. This receptor is likely to be used by the majority of the community within which it sits, including Uckington and the various rural settlements located in and around the study area. This receptor is of **medium sensitivity to change**.

13.4.16. The Cheltenham Civil Service Tennis and Football Clubs are located on the north-western edge of Cheltenham, approximately 40 m from the Scheme. These assets are likely to be used frequently by the wider Cheltenham community in their respective seasons and alternative facilities are unlikely to be available locally. However, keyaccess routes to these facilities fall outside the Scheme works area. This receptor is of **high sensitivity to change**.

13.4.17. St Mary Magdalene Church is located in Boddington to the west of the study area, approximately 500 m from the Scheme. Key access routes to this facility fall outside the Scheme works area. However, there are limited alternative facilities being available at a local level. This receptor is likely to be used by the majority of the community including Boddington and the various rural settlements located in and around the study area. This receptor is of **medium sensitivity to change**.

13.4.18. All Saints Academy is located at the western fringe of Cheltenham, approximately 180 m from the Scheme. Key access routes to this facility fall outside the Scheme works area. However, there are limited alternative facilities being available at a local level. This

receptor is likely to be used daily by the majority of the within western Cheltenham. This receptor is of **medium sensitivity to change**.

Development land and businesses

13.4.19. There are several businesses within the study area. These include, but are not necessarily limited to, the businesses below.

13.4.20. The following businesses are located in the vicinity of M5 Junction 10:

- a van hire service;
- a pub;
- a fish farm;
- a garden centre;
- a florist;
- a valeting service; and
- a horticultural nursery.

13.4.21. Although under 1 hectare, the florist, valeting service and the horticultural nursery will be subject to land take in order to construct the Scheme. A proportion of the commercial premises at Sheldon Nurseries will also be subject to demolition. These businesses are of **high sensitivity to change**.

13.4.22. The van hire service, the pub, the fish farm and the garden centre are all under 1 hectare in size. Furthermore, no direct land take will occur. These businesses are of **medium sensitivity to change**.

13.4.23. A number of businesses are located at Springbank Way Shopping Centre, located on the western edge of Cheltenham, approximately 180 m from the Scheme. This receptor is approximately 2.6 hectares in size and will not be subject to any land take. This receptor is of **high sensitivity to change**.

13.4.24. A number of businesses are located at Gallagher Retail Park, located on the north-western edge of Cheltenham adjacent to the Scheme. This receptor is approximately 8.6 hectares in size and will not be subject to any land take. This receptor is of **very high sensitivity to change**.

13.4.25. A number of businesses are located on the western edge of the Kingsditch Trading Estate, approximately 260 m from the Scheme. This section of the business park is approximately 7.4 hectares in size and will not be subject to any land take. This receptor is of **very high sensitivity to change**.

13.4.26. A pub is located on the B4634 / Withybridge Lane junction adjacent to the Scheme. This receptor is under 1 hectare in size and no direct land take will occur. This receptor is therefore of **medium sensitivity to change**.

13.4.27. A guest house is located on the B4634 approximately 500 m west of Cheltenham and approximately 350 m from the Scheme. This receptor is under 1 hectare in size and no direct land take will occur. This receptor is therefore of **medium sensitivity to change**.

13.4.28. A camper van hire company, a blacksmith and a vehicle repair shop are located on the A4019 west of Uckington, adjacent to the Scheme. These businesses are under 1 hectare in size. However, land take may be requried in order to implement the Scheme. These receptors are therefore of **high sensitivity to change**.

13.4.29. The following unimplemented commerical development allocations have been identified within the study area:

- Policy A4 – North West Cheltenham: a 10 hectare B-class office park. 13 hectares of predominantly non B-Class employment generating land; and
- Policy A7 – West Cheltenham: 45 hectares of B-class led employment land.

13.4.30. Policies A4 and A7 are considered to be of **very high sensitivity to change** as they exceed 5 ha of proposed employment land and are adjacent to the Scheme.

Agricultural land holdings

13.4.31. Agricultural land use is a mixture of grassland and arable, the latter including combinable and fodder crops. Historic Google Earth imagery idicates that some land is under long term grass, while other is under ley grass and arable rotations.

13.4.32. No information is available at the scoping stage on the precise layout and composition of individual farms, but this will be addressed in the next stage of the EIA process.

Walking, Cycling and Horseriding (WCH)

13.4.33. The following WCH information is derived from 'rowmaps' [101], an online information source that uses Ordnance Survey mapping to display PRoW mapping. The Atkins WebGIS tool has also been used to inform the understanding of baseline conditions.

13.4.34. A level of sensitivity to change has been assigned to each PRoW receptor. Key criteria that have been considered include:

- the type, location and extent of WCH provision;
- the frequency of use of the WCH provision; and
- the likelihood of severance of the PRoW.

13.4.35. Boddington Footpath 16 passes underneath the M5 adjacent to the River Chelt, approx. 800 m south of M5 Junction 10. This provides PRoW access between Boddington and Uckington. This links to another footpath that links Withybridge and Uckington. This PRoW is located adjacent to the Scheme and will be severed by the Scheme. This PRoW may provide access for commuters wishing to access Cheltenham from the west of the study area. Furthermore, limited alternative routes are available. This receptor is of **high sensitivity to change**.

13.4.36. Uckington Bridleway 1 provides access from the A4019 to Elmstone Hardwicke. This PRoW is located adjacent to the Scheme. This route is likely to be used predominantly for recreational purposes, although cyclists may use this route for commuting into Cheltenham. There are alternative routes available for walkers, but cyclists would be required to use this route. This receptor is of **high sensitivity to change**.

13.4.37. Boddington Footpath 13 provides access from the A4019 to Boddington. This PRoW is located approximately 410 m from the Scheme. This route is likely to be recreational and alternative routes are available. This receptor is of **medium sensitivity to change**.

13.4.38. Boddington Footpath 14 provides access from M5 Junction 10 to Boddington. This PRoW is located adjacent to the Scheme. This route is likely to be recreational and alternative routes are available. This receptor is of **medium sensitivity to change**.

13.4.39. Boddington Bridleway 25 and Uckington Footpath 15 provide access from Uckington to the western edge of Cheltenham. These PRoW are located approximately 80 m from the Scheme. These PRoW may provide a commuting route from Uckington to Cheltenham, although alternative access is available via the A4019. These receptors are of **medium sensitivity to change**.

13.4.40. Boddington Footpath 29 provides access from the B4634 to Hayden. This PRoW is located approximately 60 m from the Scheme. This route is likely to be recreational and alternative routes are available. This receptor is of **medium sensitivity to change**.

13.4.41. Uckington Footpath 8 provides access from the A4019 to the north of Uckington. This PRoW is located adjacent to the Scheme. This route is likely to be recreational and alternative routes are available. This receptor is of **medium sensitivity to change**.

13.4.42. Swindon Footpath 16 provides access from Gallagher Retail Park to Manor Park Business Centre. This PRoW is located approximately 200 m from the Scheme. Although this route is likely to be used for commuting from Swindon Village, there are alternative routes available with similar distances. This receptor is therefore of **medium sensitivity to change**.

[101] Rowmaps – maps showing rights of way. http://www.rowmaps.com/

Local public health profile of the study area

13.4.43. The study area falls into four electoral wards (based on the 2011 Census datasets). These are outlined and expanded upon below.

13.4.44. Data taken from the Census datasets is outlined in a series of tables in order to outline the key health baseline conditions in each of the four wards.

13.4.45. Coombe Hill and Badgeworth wards fall within the Tewkesbury local authority area, whilst Springbank and Swindon Village wards fall within the Cheltenham local authority area.

Coombe Hill

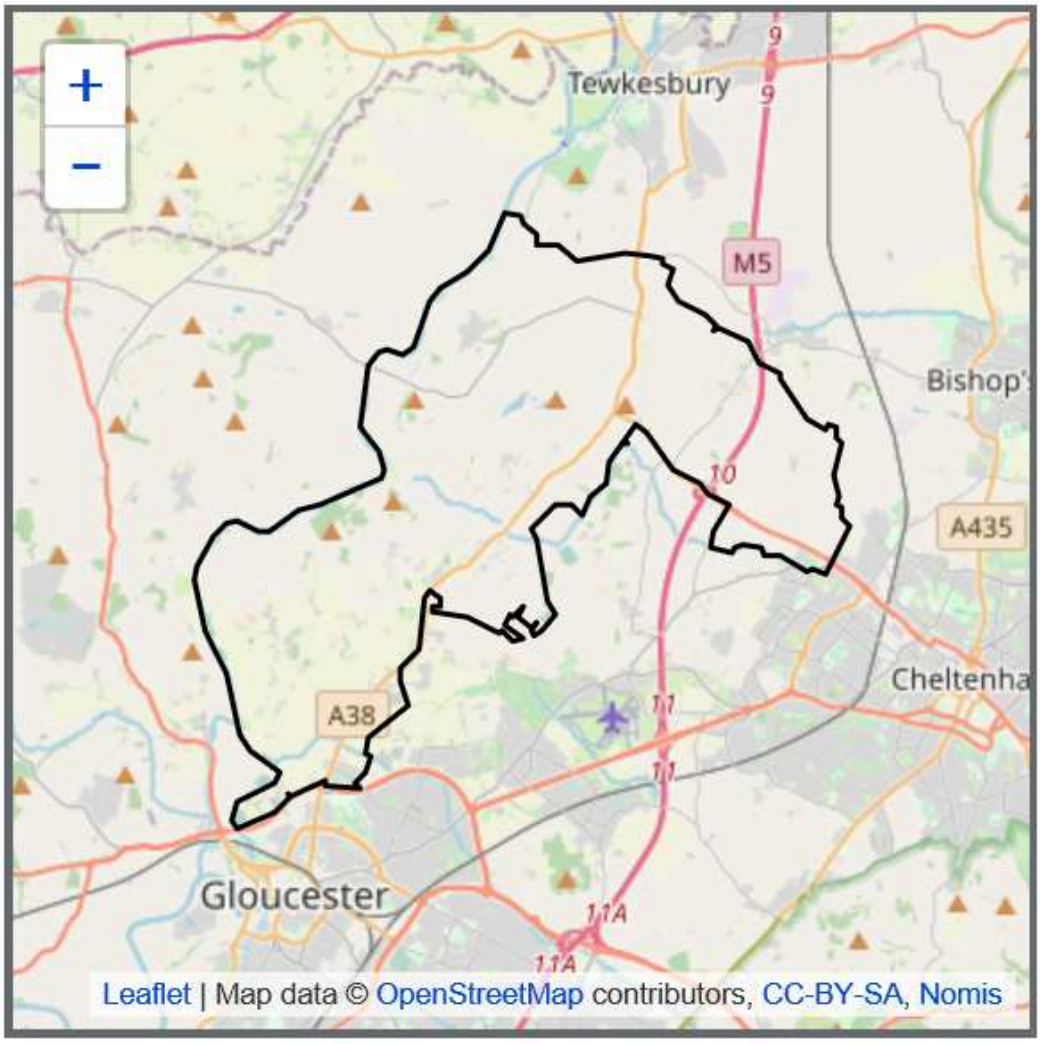

Figure 13-1 - Coombe Hill Ward Boundary

13.4.46. Coombe Hill ward is located largely to the north of Gloucester and to the west of Cheltenham. The A38 runs through the ward and provides access from Gloucester to Tewkesbury. The ward is predominantly rural and has very little settlements of note.

13.4.47. Daily movements through the study area should be limited due to the small number of residents in located within the ward. However, this section of the study area is likely to provide a key route for residents in the ward wishing to access Tewkesbury and Gloucester along the A38.

13.4.48. The ward is partially within the catchment area for Norton C of E Primary School and Deerhurst and Apperley C of E Primary School. Due to these educational facilities being located outside of the study area towards the west, there will be limited requirement for residents within this ward to cross the study area to access them.

Badgeworth

Figure 13-2 - Badgeworth Ward Boundary

13.4.49. Badgeworth ward is located directly south of the study area, and covers a large section of the study area south of M5 Junction 10. This ward also covers a largely rural area and includes few residential settlements.

13.4.50. The ward includes the M5 carriageway, south of M5 Junction 10, which provides a route from the strategic road network for vehicles to potentially access other sections of the study area through this ward.

13.4.51. The ward is partially within the catchment area for Shurdington C of E Primary School. It is unlikely that extensive numbers of residents will be required to travel through the study area in order to access this educational facility.

Springbank

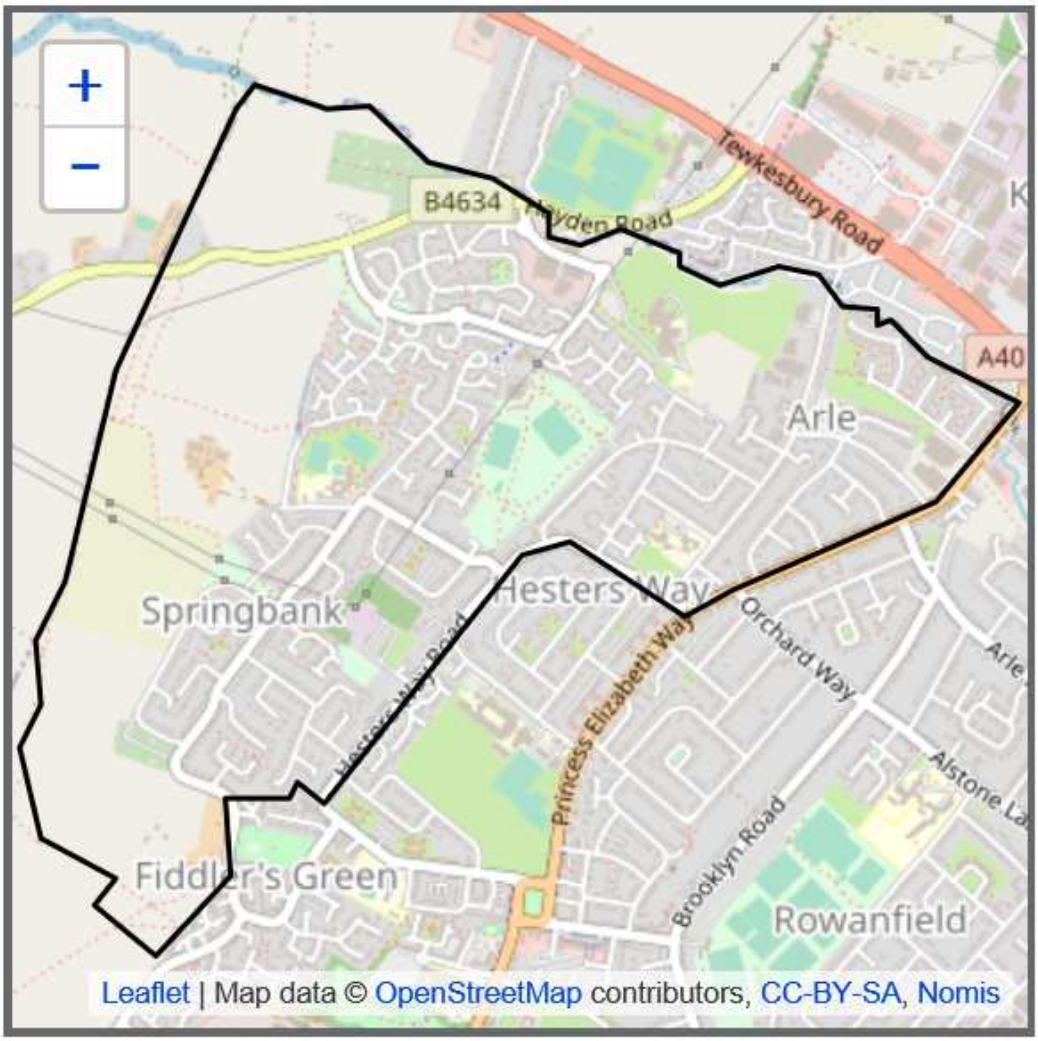

Figure 13-3 - Springbank Ward Boundary

13.4.52. Springbank ward is located at the eastern edge of the study area, on the western fringe of Cheltenham. The ward is largely residential and movements through the study area are likely in order for residents to access their properties having exited the M5 at Junction 10.

13.4.53. Many key services are provided within the ward including green open space facilities, possibly limiting extensive movements through the study area to access day to day services and facilities.

13.4.54. The ward is wholly within the catchment area for Springbank Primary Academy, All Saints' Academy (secondary) and Hesters Way Primary School. Residents within this ward are located in proximity to the educational facilities listed above and can access them without crossing the study area.

Swindon Village

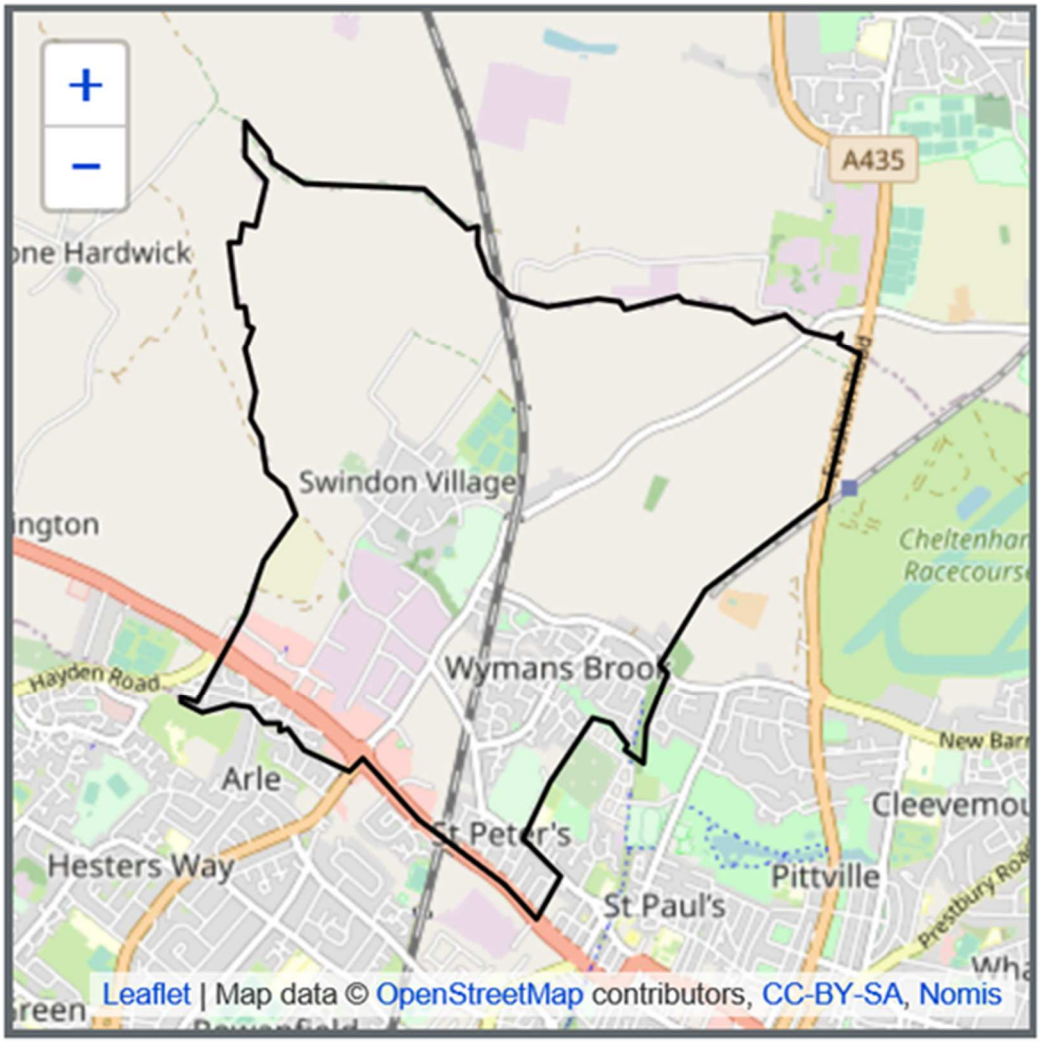

Figure 13-4 - Swindon Village Ward Boundary

13.4.55. Swindon Village ward is located located at the eastern edge of the study area, on the western fringe of Cheltenham, directly north of Springbank ward. The ward includes the residential areas of Wymans Brook and Swindon Village, although the majority of the ward is rural in nature.

13.4.56. Many key services are provided within the ward including green open space facilities, possibly limiting extensive movements through the study area to access day to day services and facilities.

13.4.57. The ward is wholly within the catchment area for Swindon Village Primary School. Residents within this ward are located in proximity to this educational facility and can access it without crossing the study area. However, travel across the study area is likely to be required in order to access secondary schools.

Health Statistics

Table 13-1 - Baseline Conditions – Human Health: Demographic Profile[102]

Location	Population	% Under 16	% Over 65
Coombe Hill	4,561	12.9%	19.1%
Badgeworth	2,113	12.3%	29%

[102] ONS 2011 Census, via www.nomisweb.co.uk

Location	Population	% Under 16	% Over 65
Springbank	6,536	20.5%	14.2%
Swindon Village	5,700	17%	13.7%
England	53,012,456	18.9%	16.4%

13.4.58. Table 13-1 displays the proportion of the local population by ward that were under 16 and over 65 in 2011.

13.4.59. In terms of the proportion of the population over 65, Coombe Hill and Badgeworth wards are above the national average, with Springbank and Swindon Village wards falling below the national average.

13.4.60. The population figures for under 16s largely mirror the figures for over 65s, with Coombe Hill and Badgeworth wards falling below the national average. Springbank ward has a higher proportion of over 65s than the national average, with Swindon Village falling just below the national average.

13.4.61. The figures indicate an overall split in terms of the distribution of age across the wards. Springbank and Swindon Village wards has a younger population overall, whilst Coombe Hill and Badgeworth wards have an older population on average, which could be construed as increased susceptibility to health issues from development when compared to the national average. The elderly and the young are both more susceptible to health issues and have a heavier reliance on primary healthcare. Both age groups will also have greater needs in terms of social infrastructure, and both age groups tend to have greater reliance on public transport, walking and cycling. These four wards are therefore considered to have a greater susceptibility to health issues in terms of the proportion of the population who are under 16 and over 65.

Table 13-2 - Baseline Conditions – Human Health: General Health of Residents [103]

Location	Very good health	Good health	Fair health	Bad health	Very bad health
Coombe Hill	46.7%	36.4%	12.5%	3.4%	1%
Badgeworth	44.3%	34.5%	14.8%	5.3%	1.1%
Springbank	46.9%	36.5%	13%	2.8%	0.8%
Swindon Village	42.2%	38.7%	13.5%	4.3%	1.3%
England	47.2%	34.2%	13.1%	4.2%	0.9%

13.4.62. Table 13-2 displays the various levels of health within the four wards. All wards are below the national average for ‘very good health’, and all wards except Springbank are above the national average for ‘very bad health’.

13.4.63. However, all wards are above the national average for ‘good health’. Furthermore, Coombe Hill and Springbank wards are below the national average for ‘bad health’.

13.4.64. The figures indicate that although the population has a higher proportion of over 65s and under 16s than the national average, this has generally not resulted in an increased susceptibility to health issues.

13.4.65. It should be noted, however, that figures for Badgeworth are generally unfavourable when compared to the other two wards.

[103] ONS 2011 Census, via www.nomisweb.co.uk

13.4.66. Table 13-3 below reflects the findings in Table 13-2, in that those whose day-to-day activities are limited a lot in Badgeworth are above the national average. Furthermore, thiose whose activities are not limited are below the national average.

13.4.67. The rest of the ward statistics are generally favourable when compared to the national average.

13.4.68. Overall, the three tables indicate that although the population has a high number of under 16s and over 65s, this is not reflected in any perceived suspectibility to health issues. However, Badgeworth ward has generally unfavourable health statistics when compared to the other three wards.

Table 13-3 - Baseline Conditions – Human Health: Health Limited Activity [104]

Location	Day-to-day activities limited a lot	Day-to-day activities limited a little	Day-to-day activities not limited
Coombe Hill	6.7%	9.5%	83.8%
Badgeworth	10.3%	11%	78.7%
Springbank	8%	8.9%	83.1%
Swindon Village	5.8%	8.4%	85.8%
England	8.3%	9.3%	82.4%

Access to community, recreational and educational facilities

13.4.69. The baseline conditions are characterised by rat-running through residential areas to gain access to the M5 at Junction 11. This can have an adverse effect on driver stress, especially during peak times.

13.4.70. Congestion and queuing are also key prevailing conditions for vehicle travellers using the M5 in proximity to Junction 10.

13.4.71. The majority of community facilities within the study area are located within the areas of townscape character to the west of Cheltenham. The more rural areas of the study area offer less options for access to community facilities, although this mirrors the density of the population who reside there.

13.4.72. It is considered unlikely that residents of the larger settlements such as Cheltenham will travel through the study area in large numbers in order to access these facilities.

13.4.73. There are regular bus services which provide public transport access access between Cheltenham, Northway and Mitton. These services pass through the study area and there is a limited reliance on the use of private vehicles to access community, recreational and educational facilities.

13.4.74. Although residents within isolated locations experience greater severance from the bus network than those within areas of dense townscape, this mirrors the the density of these settlements and there is a proportionate level of accessibility based on the density of the townscape.

Access to green space and open space

13.4.75. There is very little public green space in the study area, with much of the agricultural land being privately owned. However, the various PRoW within the study area provide WCH access to green space assets outside of the study area.

13.4.76. The majority of the study area lies within Green Belt land.

[104] ONS 2011 Census, via www.nomisweb.co.uk

13.4.77. Green and open space in the form of riverside areas at the River Chelt can be accessed from within the study area via a network of PRoW linking Cheltenham and the more rural locations to the west of the study area. The network of PRoW also provides access to green space outside of the study area, including the River Swilgate and Springfields Park.

Access to healthcare facilities

13.4.78. Residents of rural isolated settlements within the study area experience severance from key healthcare facilities located outside the study area, with the majority of GPs and dentist surgeries located within Cheltenham. This is likely to require travel along the A4019, although suitable public transport provision is available.

13.4.79. Residents at the eastern end of the study area, within west Cheltenham, experience relatively greater accessibility to healthcare facilities than those residing elsehwere in the study area, due to their relative proximity to these facilities and public transport connections.

The transport network

13.4.80. There is an extensive range of footpaths which provide pedestrian access from within and beyond the study area, allowing pedestrian access between the rural settlements. It is considered that these will primarily be used recreationally, although there would be some level of use for commuting, particularly where the PRoW provide access to Cheltenham.

13.4.81. There is much less bridleway provision in the study area, which restricts the extent to which cyclists and horse riders can travel around the study area.

13.4.82. The study area includes the A4019, which provides a key route for vehicular traffic into Cheltenham from the west. The M5 also crosses through the study area. The B4634 provides vehicular access from Bamfurlong to Cheltenham, allowing for local traffic to access Cheltenham whilst avoiding M5 Junction 10.

13.4.83. There is ample public transport provision within the study area, providing access from Cheltenham to Tewkesbury, Ashchurch and Northway.

Air quality

13.4.84. The air quality study area includes the AQMA administered by CBC for exceedances of the national NO_2 annual mean AQS objective.

Noise pollution and vibration

13.4.85. Road traffic noise from the trunk roads in the study area, such as the M5 and A4019, is the dominant source of ambient noise in the study area.

13.4.86. There are a number of Noise important Areas (NIAs) near the Scheme. Close to the M5 there are two NIAs. There is also an NIA on the A4019, to the west of Junction 10, as well as five NIAs on the A4019 to the east of Junction 10.

Pollution of soils and water

13.4.87. There are two historic landfill sites located within the Scheme study area. These are:

- Approximately 140 m north of the Scheme boundary adjacent to the M5 northbound carriageway (Colman's Farm landfill); and
- Adjacent to the Scheme boundary at the A4019, within Gallagher Retail Park.

13.4.88. There have been six recorded pollution incidents to controlled waters within the Scheme study area, the last of which occurred in 1999.

Landscape amenity

13.4.89. The Scheme is wholly located in the Landscape Character Type (LCT) 'Settled Unwooded Vale'. The key characteristics of this LCT include soft gently undulating to flat landscape,

limited woodland cover with mature hedgerow trees and mixed arable and pastoral land use.

13.4.90. The Scheme lies wholly within the SV6B: Landscape Character Area (LCA) 'Vale of Gloucester'. However, the M5 forms a spine through the heart of the Vale and there are frequent filtered views towards the motorway from the surrounding Vale landscape and the noise generated by motorway traffic is readily audible.

Transport user safety

13.4.91. Accident data for WCH is to be considered as part of the EIA assessment.

Summary of identified communities

13.4.92. Having set out the baseline conditions above in terms of matters that contribute to human health within each of the wards within the study area, this summary defines sub-communities within the study area for the purposes of assessment of Scheme impacts. Each of these sub-communities is assigned a level of sensitivity to change based on the 'community sensitivity' bands established in LA 112.

13.4.93. The definition of sub-communities is based on a qualitative judgement that evaluates known characteristics of identified receptors, in terms of their geographical location, function, likely user groups and their susceptibility to experiencing impacts from the Scheme. The geographical extents of these communities have been identified where the receptors relate to residential properties; and other sub-communities have been defined on a receptor-centric basis, such as a recreational or employment destination.

13.4.94. The following community clusters have been identified in and around the study area:

- residents of properties at north-west Cheltenham;
- residents of properties at Uckington;
- residents of properties adjacent to the B4634;
- residents of properties at Withybridge Gardens and Stanboro Lane;
- residents of properties at Withybridge Lane;
- residents of the gypsy and traveller site adjacent to the M5;
- residents of properties at Hayden;
- residents of properties at Staverton;
- residents of properties at Swindon Village;
- residents of properties at Elmstone Hardwicke;
- residents of properties at Hardwicke;
- residents of properties at Boddington;
- educational community at All Saints' Academy;
- employees at Gallagher Retail Park; and
- employees at Kingsditch Trading Estate..

13.4.95. Their sensitivity to change has been identified based on evaluating the relative experience of different communities in relation to a number of criteria, including:

- identified ward health profiles;
- the extent of options for accessibility to communities and key services;
- existing susceptibility to air, noise and light pollution;
- density of the community; and
- existing landscape amenity or townscape character.

13.4.96. The following defined communities have been identified as having **high sensitivity to change**:

- residents of properties at Withybridge Gardens and Stanboro Lane;

- residents of properties at Withybridge Lane;
- residents of the gypsy and traveller site adjacent to the M5;
- residents of properties at Uckington;
- residents of properties adjacent to the B4634;
- educational community at All Saints' Academy;
- employees at Gallagher Retail Park; and
- employees at Kingsditch Trading Estate.

13.4.97. These communities are identified as having high sensitivity due to their likelihood of experiencing disruption and/or change from the Scheme and often combined with their existing rural character, which is generally allied to good air quality, low background noise levels, tranquillity and good existing landscape amenity in a rural setting.

13.4.98. The following defined communities have been identified as having **medium sensitivity to change**:

- residents of properties at Hayden;
- residents of properties at Boddington;
- residents of properties at Elmstone Hardwicke; and
- residents of properties at Hardwicke.

13.4.99. These communities are identified as having medium sensitivity to change. Although these communities do not form part of a dense townscape, they already experience noise, air and light pollution due to their proximity to the existing road network. This could potentially reduce the perception of change that may be experienced from the Scheme, when compared to the more rural character of the receptors in the high sensitivity group.

13.4.100. Due to their relative proximity to the road network, which includes public transport routes, these communities also experience relatively greater accessibility than the highly sensitive communities.

13.4.101. The following defined community has been identified as having **low sensitivity to change**:

- residents of properties at north-west Cheltenham.

13.4.102. This community is identified as having low sensitivity due to the availability of different options for access to other communities and service centres. Furthermore, this community is considered to be an area of townscape character, as opposed to rural character; and therefore already experiences sources of light, noise and air pollution.

13.5. Assumptions and limitations

13.5.1. The following assumptions and limitations have been applied to the methodology for this assessment:

- Potential effects on population and human health receptors arising from the reassignment of traffic will be completed once relevant traffic data is available;
- The assessment provides a broad, high level indication of potential effects on population and human health, both adverse and beneficial, and is based on a proportionate assessment;
- Assessment is based upon a desk-based study of the area and professional judgement and knowledge based on previous highway schemes;
- The design of the Scheme does not currently include construction compounds, balancing ponds, flood compensation areas, ancillary works, environmental mitigations or landscaping. This will be taken into consideration during PCF Stage 3 and will require a review of the receptors and their sensitivity;
- The search for planning applications and development land provides a snapshot of the key planning developments in proximity to the Scheme. This will need to be updated periodically, including close to the submission and planned

implementation of the Scheme.

- The assessment is preliminary only and some elements will need to be refined with consultation and site work. This includes affected community assets, which will need to be subject to consultation in order to better understand their catchments, the nature of potential impacts and resultant effects, plus explore options for mitigation as appropriate. As such, there are elements of the assessment that will be confirmed in later stages of the EIA process at PCF Stage 3;
- The main limitation to the agricultural assessment in the Scoping Report is reliance on aerial imagery, farming directories and professional judgement rather than data gathered from landowners and occupiers. The assumption is that this farming information will be obtained through farm interviews at the next stage, subject to landowners and occupiers being willing to engage with the project;
- Whilst it will be possible to identify changes to some of the determinants of health likely to arise from the route options, health outcomes are dependent on multiple factors, some of which rest with individuals and/or outside the powers or influence of physical infrastructure and/or planning decisions. Identifying health effects of the Scheme and their significance will therefore be a qualitative exercise. The findings are based upon a desk-based study of the area, along with professional judgement and knowledge based on previous similar schemes. Information, where relevant, is also used from other specialist topic assessments to help to assess the magnitude of impact of the Scheme on receptors; and
- The health assessment section of this chapter is by nature a cumulative assessment that considers the human health impacts of all environmental effects of the route options. Therefore, there will be a degree of overlap between this chapter and the other technical chapters, including Air Quality, Noise & Vibration, Landscape and Road Drainage and Water Conservation.

13.6. Potential impacts – Population

Private property and housing

Construction

13.6.1. Potential impacts concerning private property and housing relate to the direct land take or partial land take of private residences. This will take place at all properties at Withybridge Gardens, three properties adjacent to Sheldon Nurseries (accessed from Stanboro Lane), two properties adjacent to the A4019, three properties at Uckington, and potentially some pitches within the gypsy and traveller site adjacent to the M5.

13.6.2. Further potential construction impacts relate to construction works adversely affecting access to the road network. This will occur in relation to the gypsy and traveller site adjacent to the M5 and may also occur at other locations within the study area, such as Stanboro Lane, Uckington and the B4364.

Operation

13.6.3. Key operational impacts are likely to relate to improved access for residents, as well as incoming residents of any committed residential schemes that will be built out in year one of the Scheme's operation.

13.6.4. However, adverse landscape impacts may occur relating to the implemented Scheme, particularly the proposed access road from the A4019 to the B4634, due to the loss of key characteristics associated with the rural setting of private dwellings.

Community land and assets

Construction

13.6.5. Scheme impacts relating to community land and assets as a result of construction works are likely to concern the introduction of severance to facilities resulting from construction works.

Operation

13.6.6. The Scheme will reduce congestion on the road network and therefore enhance accessibility to community land and assets, both within and outside the study area.

Development land and businesses

Construction

13.6.7. Land take and demolition will be required at a number of businesses within the study area, including the partial demolition of the horticultural nursery (Sheldon Nurseries) on the A4019.

13.6.8. Other key construction impacts are likely to relate to decreased access to businesses and employment sites resulting from construction works.

Operation

13.6.9. The Scheme will contribute to unlocking access to key employment allocations and employment generating development which has planning permission outside of the study area.

13.6.10. However, adverse impacts are expected relating to damage to key characteristics of the rural setting of some receptors, especially at those which are particularly sensitive to noise impacts.

Agricultural land holdings

Construction

13.6.11. All impacts on agricultural holdings will be adverse.

13.6.12. One farm building (at Uckington) is affected by the Scheme.

13.6.13. Agricultural land will be acquired in the construction phase, and most of this, estimated to be around 35 ha, will become permanent land take within the highway boundaries and permanent mitigation areas, such as attenuation ponds. The overall impact of land take depends on the size of the affected holding and its location within the farm boundary. Land taken from beside an existing road will have less of an impact than acquisition of a field for an attenuation pond or construction of a new road.

13.6.14. The main impact of the Scheme will be severance of farmland from its main farm buildings over a length of 1.4 km between the A4019 and B4634. This would be particularly important in the case of dairy farms, where the daily movement of cows between pastures and the milking parlour may be prevented by a new road. Dairy farms also differ from the other farms in having specialised capital equipment that restricts their ability to diversify. Therefore, identifying any dairy farms affected by the preferred route will be an important part of the EIA.

13.6.15. For other livestock farms severance necessitates loading and transporting animals to the severed fields, which is time consuming and disruptive to the management of the enterprise.

13.6.16. For arable farms and grass-based farms producing silage, maize and barley, additional journey times may be necessary which can slow down harvesting operations when trailers are transporting cut plants and grain to stores.

13.6.17. Other impacts to be identified and assessed will be damage to field drains and water supplies and the location of these will be obtained from the owners or occupiers of the affected farms.

13.6.18. Noise and dust may be temporary construction phase impacts.

WCH

Construction

13.6.19. Principal construction impacts of the Scheme on WCH derive from the temporary stopping up of PRoW within the study area.

13.6.20. High sensitivity receptors such as those which provide commuting routes may experience disproportionate adverse effects due to their level of use and the extent of land which the PRoW covers.

Operation

13.6.21. The majority of impacts relating to WCH are likely to relate to the construction phase. Mitigation measures set out in Section 13.8 will seek to ensure that any potentially significant construction effects are mitigated through design such that they do not endure into the operational phase.

13.7. Potential impacts – Human Health

Residents of properties at Withybridge Gardens and Stanboro Lane

Construction

13.7.1. Construction works are very likely to result in decreased amenity due to the proximity of the works for those residents occupying properties that will not be subject to demolition to facilitate the Scheme. This loss of amenity is attributed to adverse construction noise, air quality and landscape effects resulting from demolition and construction works.

13.7.2. Construction works are also likely to result in decreased ease of movement relating to access to community, recreational, educational and healthcare facilities both within and outside the study area. In particular, the interruption to access to the A4019 will severely restrict access and ease of movement for this community cluster.

13.7.3. Physical health may also be adversely affected through dust emissions and reduced air quality.

Operation

13.7.4. Adverse amenity effects during operation are likely, due to the presence of the new motorway junction infrastructure contributing to decreased air quality and reduced landscape amenity. There may also be increased noise levels arising from a reduction in intervening vegetation (in the short term) and the change in configuration of the motorway junction.

13.7.5. For those properties at this cluster that will be subject to demolition, there will be no operational effects. This includes all 14 properties at Withybridge Gardens and three properties at Sheldon Nurseries, accessed from Stanboro Lane.

Residents of properties at Withybridge Lane

Construction

13.7.6. Construction works relating to the proposed access road from the A4019 to the B4634 are very likely to result in decreased amenity due to the proximity of the works to the properties. This will relate to adverse construction noise, air quality and landscape effects resulting from demolition and construction works.

13.7.7. Decreased ease of movement relating to access to community, recreational, educational and healthcare facilities is likely to occur due to the construction works only allowing for access from the south via the B4634 and Withybridge Lane.

Operation

13.7.8. Adverse amenity effects during operation are likely, due to the presence of a new road to the east of the cluster resulting in decreased air quality and landscape amenity.

Residents of the gypsy and traveller site adjacent to the M5

Construction

13.7.9. Construction works are very likely to result in decreased amenity due to the proximity of the works to the gypsy and traveller site. This will relate to adverse construction noise, air quality and landscape effects resulting from vegetation clearance and construction works.

13.7.10. Construction works are also likely to sever the existing vehicular access to the site, adversely affecting ease of movement relating to access to community, recreational, educational and healthcare facilities both within and outside the study area. In particular, the lack of access to the A4019 will severely restrict access and ease of movement for this community cluster.

13.7.11. Physical health may also be adversely affected through dust emissions and reduced air quality.

Operation

13.7.12. Adverse amenity effects during operation are likely, due to the reconfiguration of the western boundary of the gypsy and traveller site, where it is likely that existing screening vegetation will be lost during the construction phase. This could result in decreased air quality and landscape amenity and increased experience of noise from the adjacent motorway.

Residents of properties at Uckington

Construction

13.7.13. Construction works are very likely to result in decreased amenity due to the proximity of the works for those residents occupying properties that will not be subject to demolition to facilitate the Scheme. This loss of amenity is attributed to adverse construction noise, air quality and landscape effects resulting from demolition and construction works.

13.7.14. Construction works are also likely to result in decreased ease of movement relating to access to community, recreational, educational and healthcare facilities both within and outside the study area. In particular, the interruption of access to the A4019 will severely restrict access and ease of movement for this community cluster.

13.7.15. Physical health may also be adversely affected through dust emissions and reduced air quality.

Operation

13.7.16. Adverse effects relating to physical health may occur due to a greater number of vehicles passing through Uckington along the A4019, both due to increased traffic using the route to access the reconfigured M5 J10, as well as following widening of the route, creating further capacity.

13.7.17. Adverse amenity and physical health effects may also occur due to the increased noise and decreased air quality caused by increased traffic volumes. The reconfiguration of the junction with the A4019 at Uckington may also introduce increased incidences of idling and queueing traffic, which could increase concentrations of particulates and emissions affecting this receptor. Both of these characteristics could affect the physical health of residents.

13.7.18. It is expected that ease of movement should be improved due to the likely reduction in congestion at M5 Junction 10 and the proposed dualling of the A4019.

13.7.19. For those properties at this cluster that will be subject to demolition, there will be no operational effects.

Residents of properties adjacent to the B4634

Construction

13.7.20. Ease of movement will be reduced during construction, with the properties on the west of the proposed roundabout being required to travel via Golden Valley to reach Cheltenham. Those on the east of the proposed roundabout will be able to access Cheltenham via the B4634, although access to the west will be restricted.

13.7.21. Construction works relating to the proposed access road from the A4019 to the B4634 are likely to result in decreased amenity at the residential properties to the west of the junction. The construction works may also adversely affect physical health through dust emissions and reduced air quality.

Operation

13.7.22. Ease of movement will be increased due to the proposed access road from the A4019 to the B4634 providing further access to M5 Junction 10.

Educational community at All Saints' Academy

Construction

13.7.23. Construction works may reduce access to the school due to congestion on the A4019. This is a key route for students accessing the school from the settlements both within and outside the study area.

Operation

13.7.24. The introduction of more free-flowing traffic along the A4019 due to reduced congestion could give rise to effects on physical health. Whilst reduced congestion helps to reduce concentrations of pollutants, increased speeds and throughput could increase collision risk.

13.7.25. However, ease of access to the educational facility is expected to increase due to reduced congestion.

Employees at Gallagher Retail Park and Kingsditch Trading Estate

Construction

13.7.26. Construction works in proximity to these sites may reduce accessibility for employees wishing to access the site from within the study area.

13.7.27. Amenity and physical health may also be adversely affected due to noise and air quality impacts resulting from construction works.

Operation

13.7.28. Ease of access to these sites is expected to increase due to reduced congestion on the A4019 and the wider study area.

Residents of properties at Hayden

Construction

13.7.29. Residents at Hayden may experience decreased amenity due to an increased number of vehicles travelling through Hayden in order to access Cheltenham via Golden Valley. This

may also result in adverse effects relating to physical health due to an increased number of vehicles possibly travelling at high speeds.

Operation

13.7.30. There are no notable effects relating to human health envisaged during the operational phase.

Residents of properties at Boddington

Construction

13.7.31. Residents are likely to experience decreased ease of movement due to the construction works taking place on the A4019 and Coombe Hill Junction limiting movements to the north from this cluster.

13.7.32. Residents may also experience decreased amenity due to an increased number of vehicles travelling via Boddington from the north in order to access Junction 11 of the M5.

Operation

13.7.33. Residents are likely to experience increased ease of movement relating to access to M5 Junction 10 due to decreased congestion on the A4019.

Residents of properties at Elmstone Hardwicke

Construction

13.7.34. Ease of access is likely to be reduced to the south due to construction works taking place on the A4019.

Operation

13.7.35. Residents are likely to experience increased ease of movement relating to access to M5 Junction 10 due to decreased congestion on the A4019.

Residents of properties at Hardwicke

Construction

13.7.36. Ease of access is likely to be reduced to the south due to construction works taking place on the A4019 and at Coombe Hill Junction.

Operation

13.7.37. Residents are likely to experience increased ease of movement relating to access to M5 Junction 10 due to decreased congestion on the A4019.

Residents of properties at north west Cheltenham

Construction

13.7.38. Ease of access to the M5 during construction will be adversely affected. However, alternative access is available via Junction 11 to the south.

13.7.39. Increased noise may occue during construction due to construction vehicles entering residential locations to the east of the study area.

Operation

13.7.40. Accessibility to M5 Junction 10 should be improved as a result on decreased congestion on the A4019.

13.8. Potential effects and mitigation measures – Population

Private property and housing

Construction

13.8.1. The demolition of the properties at Withybridge Gardens, Sheldon Nurseries (accessed from Stanboro Lane), and Uckington are likely to result in significant adverse effects for those residents who will be displaced from their homes to facilitate the Scheme and, in the case of the Withybridge Gardens and Sheldon Nurseries cluster, also for the substantially reduced residential community that will remain. The proposed demolition requires direct acquisition of the affected buildings, which will follow due compensation processes. For remaining residents close to the reconfigured motorway junction, there will be a need to mitigate severance through provision of revised access arrangements.

13.8.2. The requirement for land take from the gypsy and traveller site is likely to result in adverse effects due to the loss of land at the western boundary of the site and possible reduction in availability of pitches for caravans. Mitigation will be required to lessen the potential severity of these effects.

13.8.3. Access to the gypsy and traveller site will be lost during the construction phase. Mitigation will be required in the form of a replacement access outside the Scheme works to ensure that the residual effect is unlikely to be significant.

13.8.4. Although access to other private properties may be reduced within the study area as a result of construction works, the effects will be temporary and are therefore unlikely to be significant. Furthermore, appropriate traffic management measures will be implemented to further minimise and effects associated with reduced access and severance.

Operation

13.8.5. There is potential for damage to key characteristics to isolated and rural properties, particularly at Withybridge Lane and remaining residences accessed from Stanboro Lane. The provision of appropriate vegetation screening to new access routes will help to mitigate visual impacts and reinstate some of the rural characteristics over time, helping to ensure that any residual effects are not significant.

Community land and assets

Construction

13.8.6. Access to community land and assets, particularly those located within Boddington, is likely to be adversely affected during construction. However, the temporary duration of the effects will mean that the effects are not signiifcant. Furthermore, appropriate traffic management measures will further mitigate any adverse effects.

13.8.7. Where the Scheme increases traffic flows in proximity to schools and other community facilities, design should seek to minimise the effect of extra traffic on access.

Operation

13.8.8. Community land and assets will benefit from decreased severance resulting from the increased capacity on the road network.

Development land and businesses

Construction

13.8.9. The eastern section of the horticultural nursery on the A4019 (Sheldon Nurseries) will be subject to land take in order to allow for construction works to take place. This will result in a significant adverse effect due to the demolition resulting in direct acquisition and demolition of buildings. Due compensation processes will need to be followed.

13.8.10. Land take may also occur at the camper van hire company, the blacksmith and the vehicle repair shop located on the A4019 west of Uckington. It is recommended that the alignment avoids land take where possible. However, where land take does occur, due compensation processes should be followed to reduce any significant adverse effects.

13.8.11. Construction works have the potential to affect access to and from local businesses. This may be mitigated through the use of effective temporary traffic management. Access to retained premises should be maintained throughout the construction period wherever possible.

Operation

13.8.12. The Scheme is likely to result in beneficial effects relating to the unlocking of access to key employment allocations and employment generating development which has planning permission outside of the study area. Existing businesses within the study area are also likely to experience beneficial effects relating to improved access as a result of increased capacity on the road network.

Agricultural land holdings

13.8.13. Effects on agricultural holdings are assessed during construction and for the first year of operation (future year scenario). After the first year of operation, effects on land use associated with routine maintenance operations are unlikely to be significant.

- The affected farms are of medium sensitivity unless there is a dairy farm, which would be of high sensitivity.
- Land temporarily acquired for construction compounds, stockpiles, haul roads etc will be restored to its original condition at the end of the construction phase, if agriculture is the agreed end-use, and so the effect will be neutral.
- Permanent land take beside existing roads should have a negligible impact on the operation of the affected holdings and the effect slight adverse.
- Between the A4019 and B4634, the combination, without mitigation, of land take and severance, plus attenuation ponds, will have a major impact and a large adverse effect.
- If there is a dairy farm between the A4019 and B4634 the impact on its viability would be major and the effect very large adverse.
- Other impacts on field drains and water supplies and noise and dust during construction will be no more than minor and the effects slight adverse.
- There is no mitigation for permanent land take and agricultural property acquisition, apart from financial compensation which is a matter for the District Valuer and outside the scope of an EIA.
- Severance can be mitigated by the provision of alternative access arrangements. Where the status of the new road would not allow gateways off the highway or the creation of farm crossing points, accommodation tracks on either side of the new road would take agricultural vehicles to a suitable junction. There would also be financial compensation in recognition of extra journey times but this is not an environmental mitigation. With the provision of alternative access the impact of severance will be moderate and the effect reduced to moderate adverse.
- The exception would be a dairy farm, for which a dedicated crossing (overbridge or underpass) would have to be provided, reducing the impact to moderate and the effect to large adverse.

13.8.14. Field drains and water supplies will be repaired or diverted and noise and dust control measures will be implemented, as necessary, so that the effects of these minor impacts will be neutral or slight.

WCH

Construction

13.8.15. The majority of potential effects will arise from construction impacts. The overall Scheme design results in minimal significant operational effects on PRoW.

13.8.16. The closure of PRoW to construct the Scheme could amount to a significant effect if appropriate mitigation measures are not implemented. Users of affected PRoW, footpaths and cycleways should therefore be notified of planned diversions and closures, with signs along sections to be closed during construction, at least one month prior to the works.

13.8.17. Construction works should be programmed so that affected PRoW, footpaths or cycleways remain open for part, or the duration, of the construction period, and also that other routes can act as a diversion route for those affected.

13.8.18. Diversion of PRoW should follow the shortest available route, anticipated to be less than 250 m longer than the route it diverts from.

Operation

13.8.19. It is envisaged that appropriate mitigation measures, as outlined above, will ensure that no adverse effects relating to WCH will endure into the operational phase.

13.8.20. Opportunities exist for enhancement to WCH provision to be explored for delivery as part of the Scheme. These include the potential for continuous foot and cycleway to be incorporated along the A4019 and proposed Link Road; delivery of a continuous NMU route through the reconfigured motorway junction; and additional safe crossing facilities. Opportunities for increased provision for horse riders also exist, particularly in terms of crossing facilities on the A4019.

13.9. Potential effects and mitigation measures – Human Health

Access and ease of movement

Construction

13.9.1. Key adverse construction effects for access and ease of movement to community, recreational, educational and healthcare facilities primarily focus on construction works restricting movements, both through the severance of the highway and by congestion caused by construction works.

13.9.2. Where ease of movement is temporarily affected on PRoW, measures should be put in place to safely divert users around worksites and ensure safe passage. Where this is not possible, appropriate signage should be provided to direct WCH to alternative access routes.

13.9.3. In terms of affected ease of movement on the highway, effective temporary traffic management and signage should be used to guide road users to alternative access routes during the construction phase. In the case of the gypsy and traveller site, a new permanent access route will be required to mitigate the severance of the existing access during the construction phase, which is wholly within the Scheme boundary.

Operation

13.9.4. The majority of operational effects relating to access and ease of movement are likely to be beneficial, due to reduced congestion in and around M5 Junction 10.

Physical health

Construction

13.9.5. Adverse construction effects relating to physical health relate to reduced air quality and dust emissions resulting from construction works adversely affecting communities in proximity to the works.

13.9.6. Best practice mitigation measures, secured in a construction environmental management plan (CEMP) or equivalent, would help to control adverse dust impacts caused by construction works.

13.9.7. Another key construction effect relating to physical health is the possibility of increased numbers of vehicles possibly travelling at high speeds through some community clusters as a result of rat running.

13.9.8. Mitigation measures such as careful consideration of road geometry, temporary speed cameras and appropriate signage should effectively mitigate any adverse effects relating to vehicles traveling at high speeds.

Operation

13.9.9. Key operational effects relating to physical health include the introduction of free-flowing traffic resulting from decreased congestion causing an increased risk to physical health, predominantly from collision risk. This is particularly notable at clusters where vulnerable road users and pedestrians are more likely to be present. There is the potential to provide dedicated signalised crossing points on key desire lines in order to mitigate any safety concerns.

Amenity

Construction

13.9.10. Key adverse construction effects relate to increased noise, visual intrusion and reduced air quality resulting from construction works, particularly in residential clusters which enjoy rural tranquillity.

13.9.11. Best practice mitigation measures, secured in a CEMP, would help to control adverse dust impacts caused by construction works. Furthermore, best practice noise mitigation techniques to minimise the generation and impact of noise/vibration should also be implemented where possible. This includes temporary acoustic barriers, the use of rotary rather than driven piling and the restriction of some activities to less sensitive times.

13.9.12. Landscaping has an important role to play in reinstating the rural characteristics that will be affected by the construction works; and also in embedding new transport infrastructure into the landscape over time. Particular emphasis should be placed on the dual role of landscaping and landform in delivering visual and noise screening to those properties that have been noted as potentially of greatest sensitivity to changes in amenity.

13.9.13. Amenity may also be reduced through rat running resulting from the severance of access routes. Appropriate diversion signage could help to mitigate any adverse impacts on particularly sensitive communities.

Operation

13.9.14. A key operational effect relates to increased noise and decreased air quality caused by increased traffic resulting in a higher frequency of vehicles travelling within the study area. Mitigation measures which could be implemented include the use of earth bunds, noise barriers and low noise road surfacing. Speed restrictions could further mitigate any adverse effects on amenity.

13.10. Likely residual effects

Private property and housing

13.10.1. The demolition of all of the properties at Withybridge Gardens, three properties at Sheldon Nurseries (accessed from Stanboro Lane), two properties adjacent to the A4019, and three properties at Uckington are likely to result in moderate adverse to large adverse effects, which are significant. These effects cannot be mitigated, but instead would be a matter for compensation.

13.10.2. No other significant redisual effects are anticipated.

Community land and assets

13.10.3. No significant residual effects are anticipated.

Development land and businesses

13.10.4. The demolition of substantial parts of the horticultural nursery (Sheldon Nurseries) on the A4019 is likely to result in a moderate adverse to large adverse significant effect, which is significant. This effect cannot be mitigated, but instead would be a matter for compensation.

Agricultural land holdings

13.10.5. For agricultural holdings the effects, with mitigation, of the new road between the A4019 and B4634 will be moderate adverse which is significant. If there is a dairy farm there, the residual effect will be large adverse.

13.10.6. Elsewhere, and for the other minor impacts, the effect of the proposed option will be no more than slight adverse which is not significant.

WCH

13.10.7. No significant residual effects are anticipated.

13.11. Proposed level and scope of assessment

13.11.1. Significant effects relating to both population and human health are expected. Further studies are required to take place during the next stage of the EIA process to ascertain the extent of the effects on population and human health receptors.

13.11.2. The assessment of effects on population will largely focus on severance and land take of identified receptors within the study area. Levels of usage will also be taken into account when identifying the significance of effects.

13.11.3. The assessment of effects on human health will focus primarily on changes to ease of access, physical health and amenity. Whilst the majority of the assessment will focus on community clusters within the study area, clusters outside of the study area will also be considered where the Scheme is likely to result in changes to health determinants on these communities.

13.11.4. The next stage of the EIA will assess the effects of the Scheme in terms of the viability of agricultural holdings. This will be based based primarily on the impacts of land take and severance, but also on field drains and water supplies and noise and dust during construction.

13.11.5. The assessment will be based, where possible, on interviews with land owners and occupiers to obtain an understanding of the operation of their holdings and to obtain their views on impacts and possible mitigation.

13.12. Proposed Assessment methodology

13.12.1. This section outlines the methods that have been used for this Scoping Report in order to identify the baseline conditions for Population and Human Health and consider potential effects that could occur as a result of the Scheme. The methodology will generally follow DMRB LA112 (Population and Human Health).

13.12.2. Baseline data gathering for the Population and Human Health chapter has, to date, taken place principally through the collation of various online data sources. These include the following:

- 2011 Census data by ward;
- mapping applications, including Google Maps; and
- online planning application searches.

13.12.3. The search for relevant planning applications and allocated residential and employment generating development within the study area was undertaken on 14 October 2020. Unimplemented or partially implemented planning permissions granted in the vicinity of the study area were identified based on the following criteria:

- all planning applications within 250 m of the Scheme; and
- major planning applications and permissions within 500 m of the Scheme.

13.12.4. As part of the review of residential and employment generating development, the Joint Core Strategy (JCS) and the Cheltenham Plan have been reviewed in order to identify sites that may come forward that are in proximity to the Scheme.

Population

13.12.5. For the population aspect of the chapter, the Scheme Options will be considered in terms of their potential impacts upon receptors within the following topics:

- private property and housing;
- community land and assets;
- development land and local businesses;
- agricultural land holdings; and
- walkers, cyclists and horse-riders (WCH).

13.12.6. The methodology for the population assessment will follow the guidance in DMRB LA 112, which sets out the key land use and accessibility considerations listed above. The key baseline considerations have been identified under the above headings and assigned a sensitivity rating. The nature and scale of the resultant effects on each identified receptor will then be stated as either:

- beneficial;
- neutral; or
- adverse.

13.12.7. The level of significance is the product of the sensitivity of receptors and magnitude of impact. The significance of effects within this assessment will be measured according to the Significance of Effect Matrix set out in Table 4-1. The significance of effects is informed by considerations of permanence of effect (temporary or permanent), type of effect (direct or indirect) and duration of effect (short term or long term).

13.12.8. Where two potential values of significance of effect are identified, professional judgement is used to assign the value, based on understanding of details of both the magnitude of impact and value of the asset. For example, where a minor impact is identified in relation to a receptor of high sensitivity, professional judgement would be used to determine whether this results in a slight or moderate adverse effect.

13.12.9. Moderate to very large effects are considered to be “significant” in terms of the EIA Regulations 2017.

Human Health

13.12.10. The EIA Regulations 2017 require 'population and human health' to be considered amongst the other environmental topics for assessment. The Regulations do not establish the way in which the topic is to be addressed and there is no prescribed EIA definition for 'population and human health'. However, LA 112 provides prescriptive criteria for the population and health elements of the assessment. The human health determinants likely to be affected by a project are noted as:

- environmental conditions relevant to human health, including;
- ambient air quality and Air Quality Management Areas (AQMA);
- ambient noise and areas sensitive to noise;
- sources of pollution (e.g. light, odour, contamination);
- landscape amenity; and
- severance/accessibility and the ability of communities to access community land, assets and employment.

13.12.11. For human health, health receptor groups have been defined drawing on the above health determinants and professional judgement to compare demographic characteristics with likely changes arising from the Scheme, clustering to form receptors on the basis of shared physical characteristics and/or location. The impacts of the Scheme on these receptor groups will then be assessed under following topics:

- **Community assets**: accessibility and severance in relation to community, recreational and educational facilities.
- **Outdoor recreation**: accessibility and severance in relation to green space and open space.
- **Healthcare**: accessibility and severance in relation to healthcare facilities.
- **Transport network**: changes to the existing spatial characteristics of the transport network and usage in the study area, encompassing the road network, public rights of way (PRoW), cycle ways, non-designated public routes and public transport.
- **Air quality**: changes to ambient air quality and impacts for Air Quality Management Areas (AQMA).
- **Noise**: changes to noise levels and noise generation in the study area, including the presence of areas sensitive to noise such as NIAs.
- **Pollutants**: changes to the sources and pathways of potential pollution leading to light spill, odour and contamination.
- **Landscape**: changes to landscape amenity.
- **Transport user safety**: changes to risk of injury and deaths for all users.

13.12.12. The Human Health assessment will consider the effects of the Scheme on both the health of the population likely to be affected by the Scheme overall and the distribution of those impacts within the affected population.

13.12.13. For the local population overall, the key challenges to physical health, mental and social well-being generally arise from inactivity and unhealthy lifestyle choices and the way they interact with roads, traffic and the local transport network. In this context, the following form receptors that are likely to be exposed to health impacts arising from the Scheme:

- residents of properties in the core study area;
- residents using open space, greenspace and recreational facilities in the core study area;
- residents travelling to/from, and using, local services in the core and wider study areas;
- employees and customers at businesses in the core and wider study areas;
- pedestrians and cyclists using recreation routes and the local footpath, cycleway and road network;

- visitors to tourist attractions in the wider study area, and
- public transport users in the core study area.

13.12.14. It is well established in the UK and internationally that the factors that influence health and well-being within the affected population vary by age, gender, ethnicity, disability, income and social support. The most sensitive or vulnerable members in society often stand to lose the most from both the construction and operational stages of a project and this can lead to health inequality and health and social equity issues that must be addressed.

13.12.15. The assessment will consider human health to be underpinned by a number of health determinants encompassed in several environmental, social and economic aspects considered relevant to a road scheme. This includes the following, as illustrated in Table 13-4:

- **the natural environment**; air pollution; soil and water pollution;
- **built environment**; risk of injuries and death;
- **activities**: access to housing, education, health care services and other social infrastructure;
- **local economy**: access to work and training; and
- **lifestyle**: noise pollution and vibration.

Table 13-4 - Human Health determinants

Aspect	Health determinants
Natural environment	AQMAs and ambient air quality Land/water contamination
Built environment	Numbers of killed and seriously injured
Activities	Severance/separation from community, recreational and education facilities Severance/separation from green/open space
Local economy	Severance/separation from key employment sites and training facilities
Lifestyle	Noise pollution and vibration Landscape amenity Spatial characteristics of the transport network and usage in the area Severance/separation from healthcare facilities

Table Source: adapted from DMRB LA 112

13.12.16. The baseline and community health profile has been established from analysis of local socio-economic, demographic and health data in comparison with sub-regional and national data. It provides an understanding of the health determinants and receptors in the core and wider study areas, particularly the presence of any sensitive groups in the core study area that may be more vulnerable or susceptible to potential impacts.

13.12.17. Sensitivity of human health receptors depends on whether the receptor is likely to be directly affected by changes to health determinants caused by the Scheme and whether the receptor is well placed to deal with impacts.

13.12.18. The health determinants relevant to the Scheme are included in Table 13-5 below.

Table 13-5 - Human Health determinants

Health determinant	Impact to health, including to sensitive groups
AQMAs and ambient air quality	Poor environmental quality and exposure to traffic derived pollutants are linked to increased risk for physical health, including respiratory and

Health determinant	Impact to health, including to sensitive groups
	gastrointestinal problems, and lower mental health outcomes. Those with existing health issues are likely to be more sensitive. Asthma, allergies and some types of cancer are of particular concern to children.[105]
Numbers of killed and seriously injured	An individual's risk of injury may be influenced by many social, personal, economic and environmental factors. The physical environment such as transport systems and infrastructure, land use and urban development can affect the rate of incidents, injuries and death.
Land/water contamination	Soil and water pollution can lead to public health impacts directly when people encounter water and soil through recreation activities and or indirectly through the use of water for gardens and allotments watering. Polluted surface water runoff and direct migration of mobile pollutants to groundwater resources from construction vehicles, plant and high-risk activities have the potential to contaminate groundwater resources.
The location and type of community, recreational and education facilities and severance/separation of communities from such facilities	Social infrastructure covers a range of services and facilities that meet local and strategic needs and contribute towards a good quality of life. Community facilities play a vital role in supporting community interaction and facilitating recreational activities, particularly in sparsely populated rural communities. For rural communities a key aspect of maintaining this is to ensure that adequate access is provided in order for these facilities to be utilised. Housing is not just a dwelling place. It provides comfort, shelter, safety and warmth. It provides the main setting for our health throughout our lives. Good housing and physical and financial access to housing can play its part in reducing health inequalities and health harms[106]. Education plays a major role in a person's overall health and well-being[107]. Education can affect us throughout our lifetime and has been shown to increase healthy behaviours and improve health outcomes, including obesity rates. Early education is especially important because it sets the foundation for a healthy life.
The location of healthcare facilities and severance/separation of communities from such facilities	Availability and use of healthcare services that prevent and treat disease and other social infrastructure is important for promoting and maintaining health, preventing and treating disease, reducing unnecessary disability and premature death, and achieving health equality for the population. Groups more sensitive to illness, such as the elderly and children, benefit disproportionately.
Access to work and training	Income and work are two of the most important determinants of health and wellbeing[108] [109]. Employment and skills influence mental and physical health, with low education levels and unemployment linked with increased stress, lower self-confidence, increased rates of illness and premature death. Those on lower incomes due to low skills or unemployment are also less likely to be able to engage in healthy behaviours, which affect physical and mental health.

[105] WHO Ambient air pollution: Health impacts (https://www.who.int/airpollution/ambient/health-impacts/en/)
[106] Housing LIN Practice Brief (2016) Closing the health gap – a gap worth closing: How housing can play its part in reducing health inequalities (https://www.housinglin.org.uk/_assets/Resources/Housing/Support_materials/Practice_briefings/HLIN_PracticeBriefing_HealthInequalities.pdf)
[107] Economic and Social Research Council (2014) The wellbeing effect of education (https://esrc.ukri.org/news-events-and-publications/evidence-briefings/the-wellbeing-effect-of-education/)
[108] WHO The determinants of health (https://www.who.int/hia/evidence/doh/en/)
[109] Joseph Rowntree Foundation Report (2014) How does money influence health? (https://www.jrf.org.uk/sites/default/files/jrf/migrated/files/income-health-poverty-full.pdf)

Health determinant	Impact to health, including to sensitive groups
Areas recognised as being sensitive to noise (including NIAs)	Noise is linked to potential negative effects on physical, social and mental well-being[110][111]. Potential health effects identified include hearing loss or loss of hearing sensitivity, sleep disturbance, cardiovascular and physiological effects, mental health effects and behavioural effects, including poor school performance by school children.
Severance/separation from green/open space	Sufficient access to green and open space can be linked to both physical and mental health. Physical benefits from green infrastructure include improved air quality and reduced noise pollution, whilst impacts on mental wellbeing are linked to increased social interaction and reduced antisocial behaviour, isolation and stress.[112]
Landscape amenity	Landscape amenity is a key consideration in assessing the human health impacts of a scheme. There is an increasing recognition in public policy of the potential for landscapes to contribute towards better public health[113].

13.12.19. Taking into account the various health determinants outlined above, the health assessment groups each of the health determinants into the following three categories:

- Access and ease of movement;
- Physical health; and
- Amenity.

13.12.20. The methodology for assessing the nature of effects on human health does not seek to assign significance. Consequently, this section will provide a narrative on those communities identified as potentially experiencing negative health outcomes after taking account of the proposed mitigation and enhancement measures.

13.13. Proposed consultation

13.13.1. Different types of stakeholders will have wide-ranging concerns and require varied levels of information or have different interests in the Scheme (e.g. landowners versus statutory authorities). Specific communication activities therefore need to be focussed at the right level for individuals and groups. This requires an understanding of stakeholder needs.

13.13.2. Where private properties and businesses are subject to potential land take and demolition, as well as significant changes to access, the occupiers of such properties will be consulted to understand catchments and the most appropriate temporary arrangements.

13.13.3. For agricultural holdings no consultation is proposed beyond liason with affected land owners and occupiers.

13.14. Conclusion

13.14.1. This chapter sets out the methodology for the PCF Stage 3 Population and Human Health assessment of the M5 Junction 10 Improvements Scheme.

13.14.2. There are likely to be significant adverse effects relating to the demolition of some private properties and businesses. For properties directly affected by the Scheme, financial compensation may be required, which falls outside the scope of the EIA process. For retained properties proximate to the demolition works, the identified mitigation measures should reduce the severity of the residual effects of the Scheme.

[110] WHO Noise (http://www.euro.who.int/en/health-topics/environment-and-health/noise/noise)
[111] WHO Noise (https://www.who.int/sustainable-development/transport/health-risks/noise/en/)
[112] Public Health Matters (https://publichealthmatters.blog.gov.uk/2016/11/09/green-space-mental-wellbeing-and-sustainable-communities/)
[113] Public health and landscape (https://landscapewpstorage01.blob.core.windows.net/www-landscapeinstitute-org/migrated-legacy/PublicHealthandLandscape_CreatingHealthyPlaces_FINAL.pdf)

13.14.3. There are likely to be significant adverse effects relating to some agricultural land holdings, specifically between the A4019 and the B4634. Financial compensation may be required for some of these farms, which falls outside the scope of the EIA process. In the remaining instances, identified mitigation measures have the potential to reduce the severity of residual effects of the Scheme.

13.14.4. Negative health outcomes that could endure into the operational phase concern increased free-flowing traffic, causing an increased risk to physical health, principally from collision risk. The inclusion of junction amendments with signalisation may also contribute to a change in the experience of traffic derived emissions within the study area, particularly where idling and queueing traffic may be introduced. However, the implementation of mitigation measures has the potential to ensure that any health outcome may be neutral.

13.14.5. Negative health outcomes relating to reduced amenity could also endure into the operational phase. However, through the application of mitigation measures, it is considered that any health outcome has the potential to be neutral.

14. Climate

14.1.1. This chapter describes the climate change scoping assessment for the Scheme. The assessment was undertaken to ascertain the likely potential effects on climate, and the vulnerability of the Scheme to climate change, due to the Scheme during its construction and operation.

The scoping sets out:

- the study area and proposed scope and methodology for the EIA;
- the potential effects of the Scheme on climate, in particular the quantity and mitigation of greenhouse gases emitted from the Scheme during construction and operation; and
- the vulnerability of the Scheme to climate change, in particular the impacts on the Scheme of extreme weather scenarios (as caused by climate change) during operation and its adaptation for these impacts.

14.1.2. This chapter has been divided into two sub-sections in order to address the climate change requirements outlined in the EIA Regulations 2017:

- Section 1 - Effects of the Scheme on climate; and
- Section 2 - Vulnerability of the Scheme to climate change.

Introduction - Effects on Climate

14.1.3. This chapter presents the proposed methodology for assessment of the Scheme's potential effects on climate during construction and operation, aligned to the guidance set out in DMRB, Volume 11, Section 3, Part 14 Climate: LA 114.

14.1.4. The Scheme has the potential to affect the earth's climate by the emission of greenhouse gases (GHG) into the atmosphere, which will occur during construction and throughout its operational life. The earth absorbs energy from the sun and re-emits it as thermal infrared radiation. GHG in the atmosphere absorb this radiation, preventing it from escaping into space. The higher the concentration of GHG, the more heat is retained, and the higher global temperatures become. Due to human activities, the concentration of greenhouse gases in the atmosphere has increased dramatically, leading to global warming. This leads to myriad indirect impacts as the climate responds to the increased atmospheric temperature.

14.1.5. The UK has made commitments to tackle the root cause of climate change by reducing emissions of GHG, as well as to increase the resilience of development and infrastructure to the changing climate. The Climate Change Act 2008 (as amended) sets a target to reduce net GHG emissions by at least 100% from 1990 levels by the year 2050.

14.1.6. The effective assessment and management of impacts on climate offers the opportunity to reduce the impact of projects on climate by minimising the magnitude of GHG emissions as far as possible.

14.2. Study area

14.2.1. The study area comprises the emission of GHG resulting from the Scheme in its construction and operation phases. The study area is not limited to the geographic extent of the Scheme itself, as many emissions will result from upstream, downstream, and off-site activities such as materials production. In operation, the study area is consistent with the ARN defined in the traffic model.

14.3. Planning policy and topic legislative context

14.3.1. Human activities contribute to the emission of GHG such as carbon dioxide (CO_2) to the atmosphere, primarily by the combustion of fossil fuels. Greenhouse gases trap heat in

the atmosphere, with higher concentrations leading to increased global temperatures. Atmospheric CO_2 concentrations now exceed 400 parts per million for the first time in around 3 million years[114], and increased emissions have led to global average surface temperatures of 1°*C* higher than pre-industrial levels. There is a global consensus that emissions must be reduced dramatically. Relevant international, national and local policies are cited below in Table 14-1.

Table 14-1 - Policy Review

Scale	Policy Document	Policy Summary
International	Kyoto Protocol (1997)	The first international agreement to mandate greenhouse gas emission reductions. Under the United Nations Framework Convention on Climate Change (UNFCCC) treaty, industrialised nations pledged to cut their annual emissions by 5% on a 1990 baseline by 2012. Although the target was met successfully, it was insufficient to offset the increase in emissions from industrialising countries. Total global emissions continued to grow over the period, by 40% between 1990 and 2009.
	Paris Agreement (2015)	Strengthened negotiations at COP 21 led to the 2015 Paris Agreement, the aim of which is to maintain the increase in global average temperature at 'well below' 2°*C* and 'pursue efforts' to limit the temperature increase even further to 1.5°*C* . By April 2016, 190 parties, including the UK, had made voluntary pledges to reduce emissions[115], however the cumulative effect of these would still lead to an estimated 3°*C* of warming or greater. In 2018, the International Panel on Climate Change (IPCC) published a special report in response to the Paris Agreement, to present the impacts of the targeted 1.5°*C* temperature rise. The report highlighted that to achieve this, global emissions must decrease by 45% by 2030 (against a 1990 baseline), and that net zero global emissions (where emissions and removals from the atmosphere are balanced) must be achieved by 2050. This is noted to require rapid and far-reaching transitions of every sector on an unprecedented scale.
National	Climate Change Act (2008)	To support international efforts, the Climate Change Act 2008 set a legal reduction target of 80% against 1990 levels by 2050. It also introduced a series of carbon 'budgets' for five-year periods, to act as stepping-stones to the overall reduction. There are budgets currently set up to 2032. In response to the ambitions of the Paris Agreement, in June 2019 the Climate Change Act was amended to set the overall reduction target by 2050 to at least a 100% reduction in net emissions against 1990 levels, i.e. 'net zero carbon'. The UK has so far outperformed its budgets, but progress is slowing, and the country is not on track to meet its future budgets or the overall reduction target, according to the most Recent Progress to Parliament by the Committee on Climate Change[116] .
	National Policy Statement for National	The NN NPS paragraph 5.17 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.' However, the paragraph goes on to say that

[114] Atmospheric CO_2 concentrations in 2020
[115] Intended Nationally Determined Contributions
[116] Reducing UK emissions: 2020 Progress Report to Parliament - Climate Change Committee (theccc.org.uk)

Scale	Policy Document	Policy Summary
	Networks (NN NPS) (2014)	applicants should provide evidence of the carbon impact of the project and an assessment against the Government's carbon budgets. Paragraph 5.18 states that any increase in carbon emissions is not a reason to refuse development consent, unless 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 meet its carbon reduction targets. Paragraph 5.19 outlines the need for appropriate mitigation measures to be implemented in both design and construction. The effectiveness of such mitigation will be considered by the Secretary of State in order to ensure the carbon footprint is not 'unnecessarily high', with the adequacy of the measures constituting a material factor in the decision-making process. The Scheme falls within the definition of an NSIP, making the NN NPS the primary planning policy against which an application for a DCO for the Scheme would be judged.
	National Planning Policy Framework (NPPF) (2019)	Paragraph 148 outlines its support for transitioning to a low carbon future, by way of reducing greenhouse gas emissions and supporting renewable and low carbon energy and associated infrastructure. Building on the NPPF, planning practice guidance published in June 2014 advises on how to identify suitable measures in the planning process to mitigate for and adapt to climate change. Given that the Scheme is an NSIP, the NPPF has the status of a material consideration in planning terms.
	Construction 2025	Construction 2025 sets out how efficiency improvements will be created in construction covering sustainability and carbon and including a target to reduce emissions by 50%. The emissions reduction target of 50% is not scheme specific, and the efficiency improvements are broad. In terms of the Scheme and emissions reduction, the reduction target should be taken into account when developing Scheme specific mitigation measures, where relevant.
	Infrastructure Carbon Review	HM Treasury produced the Infrastructure Carbon Review (2013) to set out carbon reduction actions required by infrastructure organisations. In terms of the Scheme and emissions reduction, the reduction actions should be taken into account when developing Scheme specific mitigation measures, where relevant.
Local	Gloucestershire Joint Core Strategy (JCS) 2011-2031 (2017)[117]	Policy INF6: Infrastructure Delivery is particularly relevant to the Scheme as it makes reference to the need for additional infrastructure and services and the relevance to climate change. The policy states that the local authority should *'seek to secure appropriate infrastructure which is necessary, directly related, and fairly and reasonably related to the scale*

[117] Gloucestershire Joint Core Strategy Adopted Version 2017

Scale	Policy Document	Policy Summary
		and kind of the development proposal', including climate change mitigation and adaptation.'
	Gloucestershire's Climate Change Strategy	All Gloucestershire councils have declared a Climate Emergency. GCC's vision is stated as*: 'By 2050 we will create a carbon neutral county that provides quality of life now and for future generations, having improved the quality of our natural environment. By 2030 we will have reduced our carbon emissions by 80%.'* Following the declaration, a climate change strategy was produced to outline the actions needed to reach this target. One of eight 'themes for action' within the strategy is 'Transport – carbon busting options for all': *'As the lead highways authority (with connections to public transport) we will help to improve air quality in the six districts, encouraging a significant shift in travel behaviour, reducing car emissions in the county. We will reflect our new commitments in our Local Transport Plan[118], clearly identifying strategies to reduce carbon emissions. We will take the lead on co-ordinating the growth of electric vehicles and other low carbon transport, and the associated charging infrastructure.'* Another theme within the Strategy is 'Putting climate change at the heart of decision making'.

14.4. Baseline conditions

14.4.1. GHG emissions, from all sources, currently amount to approximately 50 billion tonnes of CO_2e[119] per year. The UK is the world's fifteenth largest emitter of CO_2e, with the total background UK emissions for 2019 (the last reported year) being 454.8 million tonnes of CO_2e. The transport sector was the largest emitting sector of UK greenhouse gas emissions in 2017, emitting 27% of all emissions. Of all sectors, it has also shown the least reduction since the 1990 baseline, at only 5%. For comparison, the next smallest reduction is seen in the agriculture sector at 13%.

14.4.2. The UK has in place carbon budgets for five-year periods up to 2032 . The UK is currently in the third carbon budgetary period (2018-2022), the budget for which is 2,544 $MtCO_2e$. The UK cannot legally emit more greenhouse gases than this within the budgetary period. The carbon budget for the 2023–2027 budgetary period is 1,950 $MtCO_2e$, and the budget for 2028-2032 is 1,725 $MtCO_2e$. Whilst budgets are not currently set beyond this, there is a legal requirement for the UK to reach 0 $MtCO_2e$ by 2050.

14.4.3. Scheme-specific baseline emissions equate to emissions in the Opening Year (2025) and Design Year assuming the Scheme was not constructed (the Do-Minimum scenario). There are no construction emissions associated with the Do-Minimum scenario. Scheme-specific baseline emissions data are not currently available, however will be presented in the ES.

14.5. Assumptions and limitations

14.5.1. The key limitation of the assessment will be the availability and accuracy of design and construction information to enable calculations. This may require assumptions to be made, and some industry standard data to be used as a proxy. The data and associated assumptions considered for the carbon emission assessment for each project stage will be presented in the ES.

[118] The Local Transport Plan is currently being revised.
[119] 2019 UK Greenhouse Gas Emissions, Final Figures (publishing.service.gov.uk)

14.6. Potential impacts

14.6.1. The Scheme will lead to a negative effect on climate in the construction phase due to the generation of emissions which would not occur in the Do-Minimum Scenario. However, it is likely that these will contribute only a small percentage of the UK's overall carbon budgets and it is therefore unlikely that any of the options would generate a significant effect on climate. This is in line with the policy position set out in the NN NPS (paragraph 5.17): *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.*

14.6.2. During operation, there is the potential for a positive or negative effect on climate, depending on the balance between additional vehicles which may be added to the road network compared with improvements in traffic flow. However, with reference to the NN NPS, it is considered unlikely that any effects from operation would be of a sufficient magnitude to constitute a significant effect. However, mitigating effects on climate is still an important issue, and the Scheme design will take climate effects into consideration.

14.7. Potential effects and mitigation measures

14.7.1. The construction of the Scheme will affect the climate by causing the emission of greenhouse gases in the following activities:

- Production of construction materials, including primary raw material extraction, manufacturing and intra-manufacturing transportation;
- Transportation of materials and workforce to the construction site;
- Combustion of fuel to generate energy for use during construction;
- Treatment and transport of water for use during construction; and
- Transport, treatment and/or disposal of waste generated during construction.

14.7.2. The operation of the Scheme has the potential to affect the climate by causing the emission of greenhouse gases in the following activities:

- Vehicles using highways infrastructure;
- Energy consumption for infrastructure operation and activities of organisations conducting routine maintenance; and
- Ongoing land use GHG emissions/sequestration each year.

14.7.3. Design and mitigation should be carried out in line with DMRB LA 114, which uses the principles set out in PAS 2080:2016 'Carbon Management in Infrastructure'. LA 114 states that: 'Projects shall seek to minimise carbon emissions in all cases to contribute to the UK's target for net reduction in carbon emissions'.

14.7.4. Emissions should be mitigated by applying Highways England's carbon reduction hierarchy: Avoid / Prevent, Reduce, Remediate. As a project progresses, the opportunity to make significant carbon reductions reduces, and the cost and disruption associated with those changes increases. It is therefore important to plan to integrate these opportunities from this early project stage.

14.7.5. **Avoid / prevent**: The opportunity for the greatest reduction in carbon emissions is typically found right at the beginning of a project, when the strategy for meeting objectives is decided. Materials and construction processes can be reduced to great effect by changing the approach to the problem and reducing the amount of hard engineering required.

- Maximise potential for re-using and / or refurbishing existing assets to reduce the extent of new construction required; and
- Explore alternative lower carbon options to deliver the project objectives (i.e. shorter route options with smaller construction footprints).
- Give particular consideration to how materials which are key emission sources can be reduced. Note that if reducing these materials would increase use of another, it will be important to assess whether the net effect is a carbon benefit.
- Avoid disturbance / removal of existing vegetation and soils as far as possible, to

reduce loss of carbon to the atmosphere.

- Incorporate elements into the Scheme which will encourage a reduction in user emissions, for example modal shift to more sustainable forms of transport. Note that the carbon benefits of any additional infrastructure, e.g. cycle paths and footpaths, should be weighed against the carbon cost of additional construction activities to ensure the best whole-life carbon approach is taken.

14.7.6. **Reduce**: During design, there is opportunity to use smart engineering solutions to reduce carbon. Key things to consider will be the use of innovative low-carbon materials, and how to set the Scheme up for efficient delivery by design interventions.

- Apply low carbon solutions (including technologies, materials and products) to minimise resource consumption during the construction, operation, user's use of the project, and at end-of-life.
- Construct efficiently, using techniques (e.g. during construction and operation) that reduce resource consumption over the life cycle of the project.
- Specify the use of recycled materials rather than virgin alternatives, for example: recycled aggregate, or recycled plastic materials. Note that the benefits of using recycled materials should be weighed against potential carbon costs. For example, local virgin material may have a lower overall carbon impact than recycled material sourced from a great distance.
- Design for zero carbon operation. The Scheme should be passive (non-energy consuming) where possible, with renewable technologies to supply energy needs where not.
- Design for low-carbon maintenance. Preferentially select long-life options which will require as little maintenance and infrequent replacement as possible.
- Design with deconstruction in mind, taking a 'circular' approach where all elements could be disassembled and materials reused at end of life. Consider the Scheme as a 'material bank' which will be a source of materials rather than waste at the end of its life.
- Work with the supply chain to understand the carbon impact of products / materials, and challenge them to reduce this.
- Recycle waste rather than sending to landfill.
- Avoid materials which come in disposable packaging, particularly that which cannot be recycled. Work with supply chain to develop alternative packaging and delivery options.
- Specify materials sourced as locally as possible, to reduce transport. During design, consider whether elements which cannot be sourced locally can be designed out or a different solution used.
- Use more sustainable means of transporting materials to site.
- Use local workforce to reduce emissions from commuting and business travel. Make use of video conferencing and other digital technologies to reduce vehicle trips.
- Mandate preparation of a construction workforce travel plan which maximises vehicle sharing and reduces trip numbers. Encourage the contractor to make use of smart scheduling software.
- Use renewable energy onsite, for example solar lighting, and fuel cell electric welfare units.
- Mandate use of electric and other low-carbon construction plant as standard on the Scheme. To make best effect of this measure, plant should be charged from renewable sources. Diesel should be used as a last resort when no renewable option is available.
- Mandate use of electric vehicles (EVs) to transport workers, and provide EV charging points at site. As with construction plant, electricity should be generated from renewable sources.

14.7.7. **Remediate:** After addressing steps 14.7.5 and 14.7.6, the project will identify, assess and integrate measures to further reduce carbon through offsetting or sequestration, on-site or off-site.

- Maximise vegetation cover to enhance carbon sequestration. Give careful thought to the species selected, as sequestration rates vary, and also to how vegetation will be managed on an ongoing basis. Vegetation which requires frequent intervention (grass cutting, hedge trimming) may generate more emissions than it sequesters.
- Install renewable energy technologies which exceed the consumption requirements of the Scheme and feed into the National Grid to offset emissions.
- Use wood for permanent design elements. This can provide a long-term store for carbon in the built environment. Sustainable procured wood from local sources should be procured where possible.
- Once opportunity to reduce and sequester carbon emissions within the development boundary has been maximised, consideration may need to be given to financing third-party projects. In order of preference, these could be:

- Collaborative approach: Work with the local Wildlife Trust, nature partnerships and other groups trying to achieve similar goals, to support local projects by incorporating them into the development.
- Green funds: Provide funding for local third-party landowners to plant and manage woodland and other beneficial land-uses for sequestration and implement renewable energy technologies.
- External offset: Purchased through external offset companies, these might include renewable energy projects, energy efficiency projects, landfill gas recovery, and community projects.

14.8. Likely residual effects

14.8.1. There will be residual emissions, probably not significant effect as per NN NPS. There will be potential to bring residual effects to net zero through offsetting and changes in UK fleet with government plans.

14.9. Proposed level and scope of assessment

14.9.1. LA 114 requires consideration of two questions to determine whether further assessment of effects on climate is required:

- Are construction GHG emissions (or GHG-emitting activity), compared to the baseline scenario (i.e. when compared to GHG emissions and energy use associated with existing maintenance activities), increasing by >1%?
- During operation, will roads meet or exceed any of the following criteria?
- A change of more than 10% in AADT;
- A change of more than 10% to the number of heavy duty vehicles; and
- A change in daily average speed of more than 20 km/hr.

14.9.2. As baseline emissions from existing maintenance activities are likely to be low, it is considered likely that construction of the Scheme will increase GHG emissions by more than 1%, and further assessment should therefore be carried out.

14.9.3. The DMRB LA114 also advises on the level of assessment which should be carried out, based on the expected level of data availability at the project stage. Where there is insufficient reliable information for quantitative assessment, a qualitative assessment of GHG emissions shall be completed in the early stages of project development.

14.9.4. It is anticipated that quantitative design information will be available during the PCF Stage 3 design. For this reason, a fully quantitative assessment will be provided in the ES.

14.9.5. The life cycle stages and GHG sources presented in Table 14-2 will be included within the assessment.

Table 14-2 - Sources and lifecycle stages for project GHG emissions

Main stage of project life cycle	Sub-stage of life cycle	Potential sources of GHG emissions (not exhaustive)
Construction stage	Product stage; including raw material supply, transport and manufacture.	Embodied GHG emissions associated with the required raw materials.
	Construction process stage; including transport to/from works site and construction /installation processes.	Activities for organisations conducting construction work
	Land use change.	GHG emissions mobilised from vegetation or soil loss during construction.
Operation ('use-stage') (to extend 60yrs in line with appraisal period)	Use of the infrastructure by the end-user (road user).	Vehicles using highways infrastructure.
	Operation and maintenance (including repair, replacement and refurbishment).	Energy consumption for infrastructure operation and activities of organisations conducting routine maintenance.
	Land use and forestry.	Ongoing land use GHG emissions/sequestration each year.
Opportunities for reduction	GHG emissions potential of recovery including reuse and recycling GHG emissions potential of benefits and loads of additional functions associated with the study system.	Avoided GHG emissions through substitution of virgin raw materials with those from recovered sources.

Source: Adopted from LA114.

14.10. Proposed assessment methodology

14.10.1. This methodology is aligned to the guidance set out in DMRB, Volume 11, Section 3, Part 14 Climate: LA 114, to the extent that it is applicable at this early stage in the Scheme's development. The effective assessment and management of impacts on climate offers the opportunity to reduce the impact of projects on climate by minimising the magnitude of GHG emissions as far as possible.

14.10.2. The assessment will estimate the scale and nature of GHG emissions during the construction and operation stages of the project life cycle.

14.10.3. A proportionate approach will be adopted focusing on capturing the principal contributing factors to the effects on climate, quantifying the magnitude of emissions and assessing the significance of these.

14.10.4. Emissions calculations will be carried out by multiplying activity data by an emission factor associated with the activity being measured. Activity data is a quantitative measure of an activity that results in emissions during a given period of time, (e.g. kilometres driven, kWh electricity consumed, tonnes waste sent to landfill). An emission factor is a measure of the mass of emissions relative to a unit of activity.

14.10.5. Scheme emissions wil be quantified by calculation, using project data from the emerging design and relevant carbon conversion factors.

14.10.6. For the construction stage of the Scheme, calculations will be undertaken by using Highways England's Carbon Tool, which will allow comparison of the results to other highway scheme assessments using the same tool. The Carbon Tool is an excel spreadsheet-based tool, that allows us to input material and non-material construction information under the following categories:

- Bulk materials
- Earthworks
- Fencing, barriers and road restraint systems
- Drainage
- Road pavements
- Street furniture
- Civil structures and retaining walls
- Fuel, electricity and water use
- Business and employee transport
- Waste

14.10.7. Operational emissions will be calculated separately from Highways England's Carbon Tool, which is focused specifically on construction-phase emissions. Road user carbon emissions will be modelled in accordance with LA 105 Air quality (formerly HA 207/07, IAN 170/12, IAN 174/13, IAN 175/13, part of IAN 185/15) of Nov 2019. Emissions will be calculated using DEFRA's Emissions Factors Toolkit (v8), which takes account of DfT fleet projections including conventional vehicles (petrol and diesel) as well as hybrid and electric vehicles.

14.10.8. Operational emissions beyond road user emissions will be calculated based on estimated annual energy emissions, plus an estimate made of maintenance and refurbishment works.

14.10.9. Emissions and removals associated with land use change may be assessed if it is considered that significant areas of land use change will occur, as set out in LA114.

Emissions Analysis and Significance Assessment

14.10.10. Emissions calculated for the Do Something scenario of the Scheme will be compared against the Do Minimum scenario baseline for the assessment years. The difference between these emissions can be considered to be the impact of the Scheme.

14.10.11. The assessment of the project's effect on climate will report the quantities of GHG emissions in metric tonnes of carbon dioxide equivalents (tCO_2e).

14.10.12. A comparison of the magnitude of Scheme emissions with the UK's carbon budgets will be presented and used to establish a level of significance of the effects on climate.

14.10.13. There is no accepted technical or policy guidance for determining a level of significance of the effect of emissions on climate from a development. There is also no legal limit for emissions for any one development, although there is global consensus that atmospheric warming should be kept to below 2^oC and the UK Government has set national carbon budgets to 2032 and an overall target for 2050.

14.10.14. The emission of GHG is certain to lead to a direct, long-term negative impact (global warming) on a highly sensitive and internationally significant receptor (the atmosphere) no matter the location of the emission source. The effect is currently irreversible without significant technological development, and will continue after the lifespan of the proposed development. These considerations apply to all emissions, generated from any source, in any location.

14.10.15. The level of significance of the impact (i.e. whether it is minor or moderate) is therefore based solely upon the magnitude of emissions generated in the context of the UK's carbon budgets, and as assessment of whether the Scheme would have a material impact on the UK's ability to meet its reduction targets.

14.11. Vulnerability to major accident and disasters

14.11.1. Major accidents or disasters which would require repair, maintenance or replacement works to be carried out would lead to additional GHG emissions beyond those anticipated in normal operation. It is not possible to carry out quantitative assessments of potential outcome, and no assessment of any specific scenarios will be included in the ES.

14.12. Proposed consultation

14.12.1. No specific consultation is proposed.

14.13. Conclusion

14.13.1. An assessment of the Scheme's effects on climate from emissions of GHGs will be carried out, in accordance with DMRB LA 114 Climate.

14.13.2. Table 14-3 shows the proposed scope of assessment for effects on climate

Table 14-3 - Proposed scope of assessment for effects on climate

Main stage of project life cycle	Sub-stage of life cycle	Potential sources of GHG emissions (not exhaustive)	Scoped In / Out	Comments
Construction stage	Product stage; including raw material supply, transport and manufacture.	Embodied GHG emissions associated with the required raw materials.	Scoped In	
	Construction process stage; including transport to/from works site and construction /installation processes.	Activities for organisations conducting construction work	Scoped In	
	Land use change.	GHG emissions mobilised from vegetation or soil loss during construction.	Scoped In	
Operation ('use-stage') (to extend 60yrs in line with appraisal period)	Use of the infrastructure by the end-user (road user).	Vehicles using highways infrastructure.	Scoped In	
	Operation and maintenance (including repair, replacement and refurbishment).	Energy consumption for infrastructure operation and activities of organisations conducting routine maintenance.	Scoped In	
	Land use and forestry.	Ongoing land use GHG emissions/sequestration each year.	Scoped In	

Main stage of project life cycle	Sub-stage of life cycle	Potential sources of GHG emissions (not exhaustive)	Scoped In / Out	Comments
Opportunities for reduction	GHG emissions potential of recovery including reuse and recycling GHG emissions potential of benefits and loads of additional functions associated with the study system.	Avoided GHG emissions through substitution of virgin raw materials with those from recovered sources.	Scoped In	

Introduction - Vulnerability to Climate

14.13.3. This part of Chapter 14 outlines the assessment of the exposure and resilience of the Scheme to the effects of climate change during construction and operation. The approach is aligned to the guidance set out in DMRB, Volume 11, Section 3, Part 14 Climate: LA 114, 2019[120]; herein refered to as LA114.

14.14. Study area

14.14.1. The study area for the assessment of potential impacts on the Scheme will be based on the construction footprint/project boundary (including compounds and temporary land take). These are shown in Figure 2-5.

14.14.2. Potential impacts on environmental receptors that could be intensified by climate change will be assessed as cumulative effects. The spatial boundary for this assessment will therefore incorporate the areas of all the receptors examined by the environmental topics set out in this report.

14.15. Planning policy and topic legislative context

14.15.1. The legislation and policy framework for the Scheme's vulnerability to climate changes is set out in Table 14-4.

Table 14-4 - Policy Review

Scale	Policy Document	Key Implication for the Scheme
National	Infrastructure Planning (Environmental Impact Assessment) Regulations 2017	The Regulations require: "A description of the likely significant effects of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change."
	National Policy Statement for National Networks (NN NPS, 2014)	The Scheme falls within the definition of an NSIP, making the NN NPS the primary planning policy against which an application for a development consent order (DCO) for the Scheme would be judged. Paragraph 4.41 states that new national networks infrastructure should typically be long-term investments which

[120] https://www.standardsforhighways.co.uk/prod/attachments/87f12e4f-70f8-4eed-8aed-9e9a42e24183

Scale	Policy Document	Key Implication for the Scheme
		should remain operational over “many decades in the face of a changing climate”. Therefore, applications should “consider the impacts of climate change when planning location, design, build and operation”. Paragraph 5.19 outlines the need for appropriate mitigation measures to be implemented in both design and construction. The effectiveness of such mitigation will be considered by the Secretary of State in order to ensure the carbon footprint is not ‘unnecessarily high’, with the adequacy of the measures constituting a material factor in the decision-making process.
	National Planning Policy Framework (NPPF, 2019)	Given that the Scheme is an NSIP, the NPPF has the status of a material consideration in planning terms. The NPPF develops a planning system that contributes to radical reductions in greenhouse gas emissions, minimises vulnerability and improves resilience; encourages the reuse of existing resources, including the conversion of existing buildings; and supports renewable and low carbon energy and associated infrastructure. The NPPF states that “New development should be planned for in ways that avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure. Paragraph 149 states that policies should “support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts”. Building on the NPPF, planning practice guidance published in June 2014, advises on how to identify suitable measures in the planning process to mitigate for and adapt to climate change.
	Climate Change Act 2008	The UK passed legislation that introduced the world's first long term legally binding framework to tackle the risks posed by climate change. The Climate Change Act (2008) created a new approach to managing and responding to climate change in the UK, by: • Setting ambitious, legally binding reduction targets; • Taking powers to help meet those targets; • Strengthening the institutional framework; • Enhancing the UK's ability to adapt to the impacts of climate change; and • Establishing clear and regular accountability to the UK Parliament and to the developed legislatures. Key provisions of the Act in respect of climate change adaptation include a requirement for Government to report, at least every five years, on the risks to the UK of climate change, and to publish a programme setting out how these will be addressed. This Act also introduces powers for Government to require public bodies and statutory undertakers to carry out their own risk assessment and make plans to address those risks. The Adaptation Sub-Committee of the Committee on Climate Change will provide advice to, and scrutiny of, the Government's adaptation work.

Scale	Policy Document	Key Implication for the Scheme
	The Highways Agency Climate Change Adaptation Strategy and Framework (2009)	The Climate Change Act (2008) led to modifications in existing standards on the national network. The Highways Agency has committed to assessing the potential risks that climatic changes pose to the ongoing management, maintenance, improvement, and operation of the strategic road network. This document sets out how the UK's road network may be vulnerable to climate change and how these vulnerabilities will be factored into the delivery of their business, along with the development of appropriate management and mitigation solutions to remove or reduce the vulnerabilities.
	Highways England Sustainable Development Strategy and Action Plan (2017)	Highways England recognise that changes in climate may result in more frequent and severe weather events. This document sets out their commitment to ensure resilience to climate change is embedded in the activities of their business to reduce whole life costs and increase safety. To do this their ambition is to invest for the long-term – "our road network contains components that have a very long design life, such as bridges and tunnels; they will require timely and cost effective investments to reduce the risk of increased future costs, whilst improving resilience to climate change."
Regional	Gloucestershire Waste Core Strategy (2012)	LTP PD 4.2 – Highway network resilience makes specific reference to the importance of a 'resilient highway network that can withstand unforeseen events including extreme weather events and long-term changes to the climate.' This will be achieved through the identification of the most vulnerable parts of the transport network and developing contingency plans to ensure a functioning network during unplanned events. Importantly, as part of this policy, Gloucestershire County Council also pledge to 'continue to deliver highway and flood alleviation schemes which reduce the risk of highway closures on class one and two routes', as well as work with the Environment Agency, Highways England and communities to 'ensure that the highway network and the communities, trade and commerce that it serves are better protected from flood impacts.'
	Gloucestershire County Council Strategy & Action Plan for Responding to Climate Change (2008)	The document outlines the Council's objective to understand and manage the risks that a changing climate will have on the delivery of Council services. It also ensures that they help Gloucestershire's communities become more resilient to climate change, building on their good practice in responding to the floods in the summer of 2007. More than 15 different direct impacts of climate change are identified and discussed.
Local	Cheltenham Borough Council Climate Change Strategy (2005)	CBC recognise the importance of tackling climate change on two fronts; reducing greenhouse gas emissions to minimise future climate change and planning for the unavoidable impacts of climate change. This document provides a framework for addressing both these issues. Chapter 7 outlines the expected impacts of climate change on Cheltenham and proposes a number of associated adaption measures.
	Tewkesbury Borough Council	Sets out how adaptation measures will be planned to allow TBC to continue to meet service delivery requirements, and care for the community, in the face of climate change. The Strategy identifies agriculture, biodiversity, settlements,

Scale	Policy Document	Key Implication for the Scheme
	Climate Change Strategy	business and water as the sectors most vulnerable to climate change in its administrative area.
	Gloucester City Council Climate Change Strategy (2010)	The strategy encourages individuals to reduce the level of transport related emissions by travelling less by car and walking, cycling and using public transport more. Other ideas such as car share and car clubs are also promoted.

14.16. Baseline conditions

14.16.1. Climate is defined as the typical weather conditions experienced in a place over a period of time, conventionally expressed as average weather over a 30-year period.

14.16.2. The baseline for climate change vulnerability is presented in two parts:

- The first section describes the current climatic conditions in the study area;
- The second presents a range of possible future climate projections in the study area.

14.16.3. It should be noted that climate change is not only a challenge for the future. The UK is already observing changes in its climate.

Current climate

14.16.4. The Scheme is situated within the River Severn catchment. To inform adaptation decisions this section presents data from the Meteorological Office to summarise the River Severn's catchment current climate. The Met Office's standard average data tables are used, they show the latest set of 30-year averages covering the period 1981-2010. Context to this is provided by including comparison to the equivalent national dataset (UK minimum, average and maximum temperatures).

14.16.5. To support the above average regional data a local dataset has also been collected from the closest long running climate station to the Scheme. The closest climate station is located at Ross-On-Wye (359800E, 223800N) and has been recording observations since 1931.

Current temperature

14.16.6. The climate in the River Severn catchment is one of relatively mild winters and warm summers. As shown in Figure 14-1 and Figure 14-2, monthly average and mean maximum temperatures are high for the UK. Across the timeseries, 1981-2010, peak summer (July) average maximum temperatures of 22 °C in the River Severn catchment are equal to the maximum across the UK. Note that mean maximum temperatures are calculated as the monthly average of daily maximums – as such some individual days are likely to have recorded hotter temperatures than those stated.

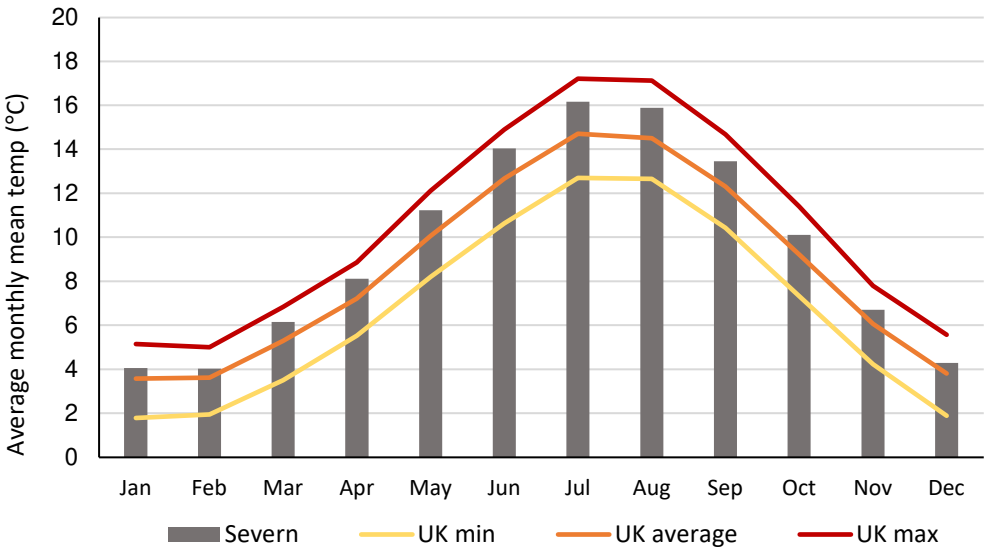

Figure 14-1 - Long-term average monthly mean temperature (°C) (1981-2010)

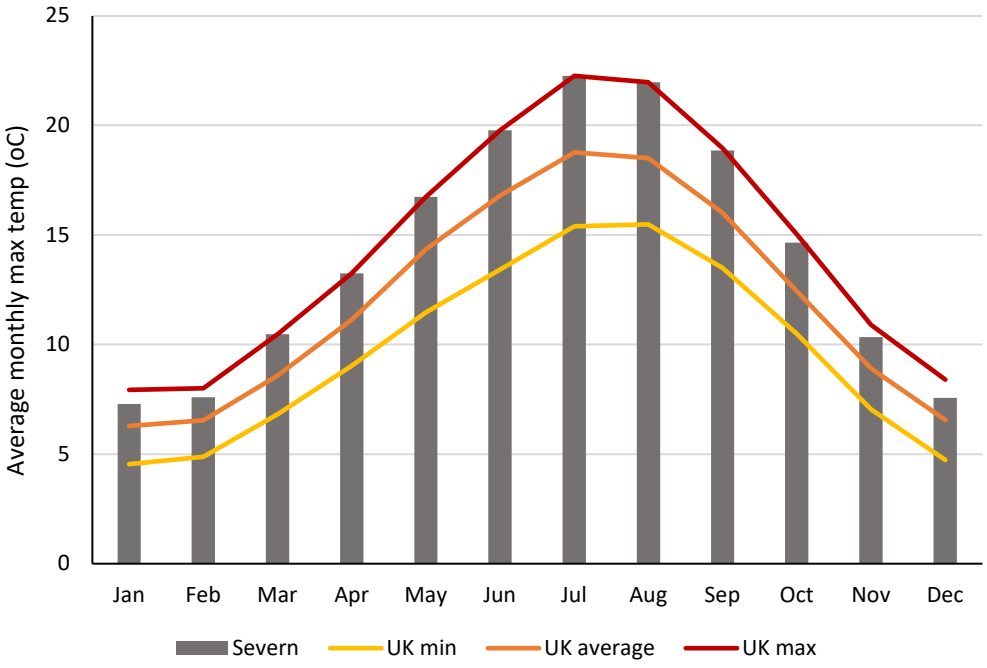

Figure 14-2 - Long-term average monthly maximum temperature (°C)(1981-2010)

Note: the maximum data presented is a monthly average of daily maximums

14.16.7. Observations for the UK show that the decade leading up to the publication of UKCP18 (2008-2017) was on average 0.3°C warmer than the 1981-2010 average and 0.8 °C warmer than 1961-1990. All of the top ten warmest years have occurred since 1990.

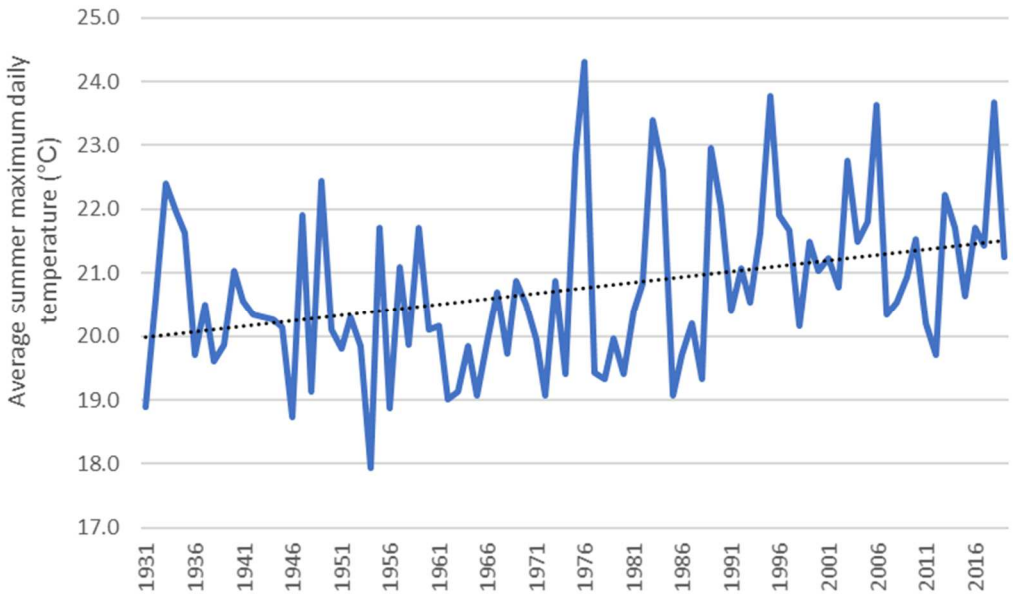

Figure 14-3 - Average summer maximum daily temperature (°C) (1930-2019) (Ross-On-Wye)

14.16.8. Observation from the Ross-On-Wye climate station reveal that three of the five highest monthly mean daily maximum temperatures (t-max) it has recorded have been since 2006. They also show that over the period 1930 to 2019 both the average daily summer maximum temperatures and average daily winter maximum temperatures have been increasing (conclusion based on linear trendlines on Figure 14-3 and Figure 14-4.

Figure 14-4

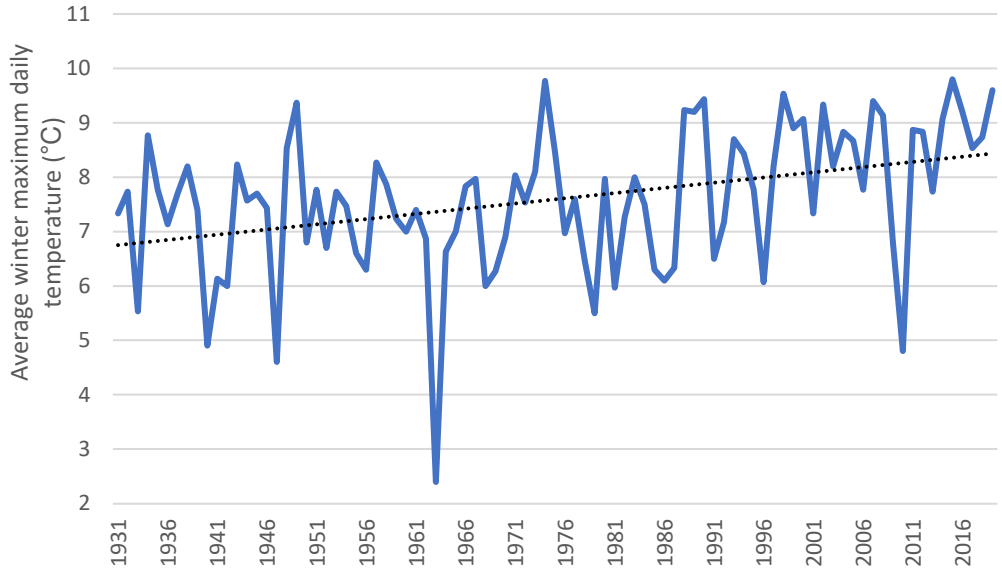

Figure 14-4 - Average winter maximum daily temperature (°C) (1930-2019) (Ross-On-Wye)

14.16.9. As shown in Figure 14-5 the long-term average days with ground frost (1981-2010) in the River Severn catchment are close to average for the UK.

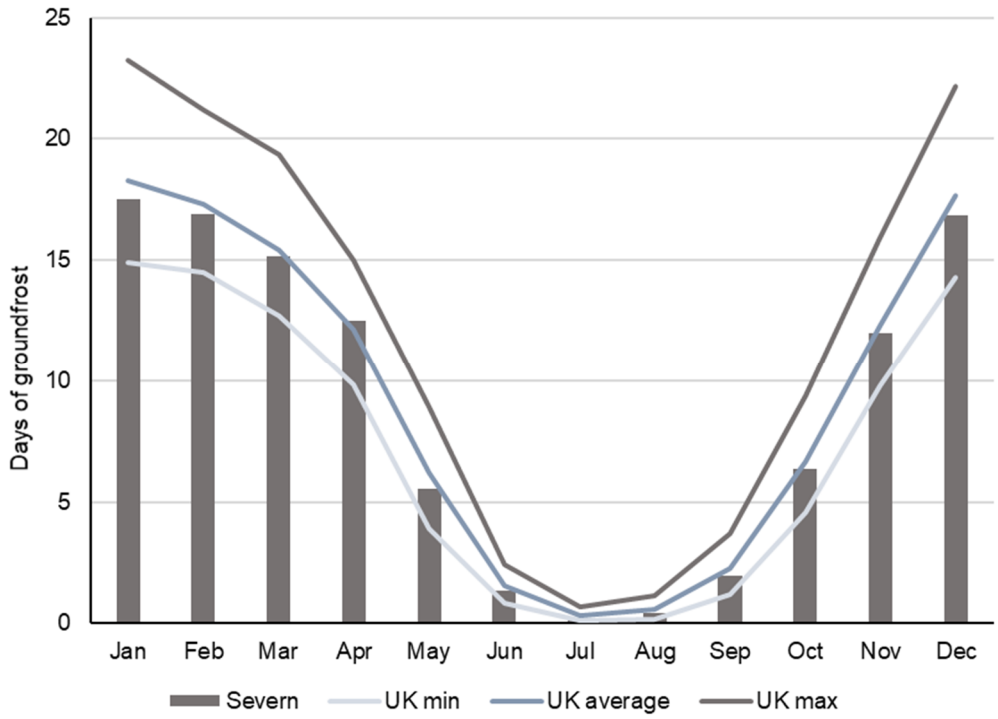

Figure 14-5 - Long-term average days with ground frost (1981-2010)

14.16.10. In accordance with the observed increasing winter temperatures (see Figure 14-4) the linear trendline on Figure 14-6 shows the number of days with air frost each winter has been reducing since 1930.

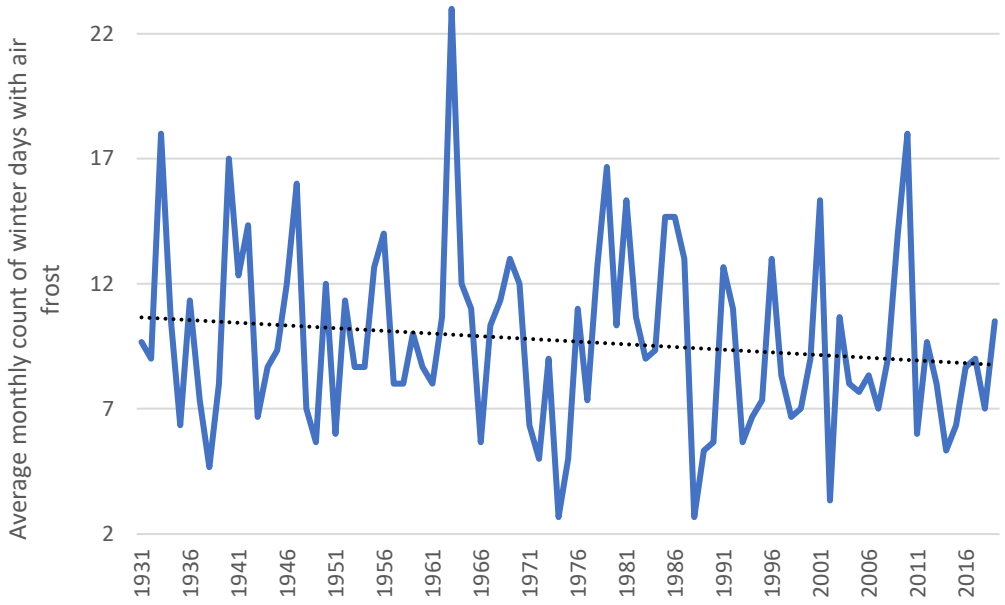

Figure 14-6 - Average monthly count of winter days with air frost (1930-2019) (Ross-On-Wye)

Current precipitation

14.16.11. Observations across the UK show a high level of variability in precipitation from year to year, with a slight overall increase in UK winter precipitation in recent decades.

14.16.12. As shown in Figure 14-7, long-term average monthly rainfall (1981-2010) in the River Severn catchment is below average for the UK.

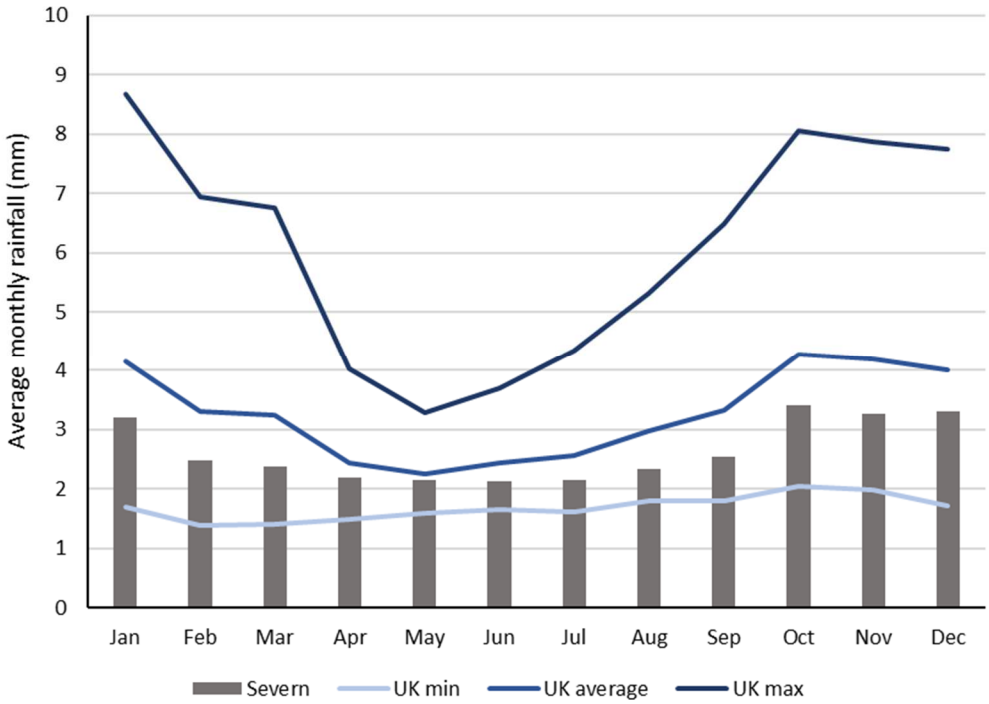

Figure 14-7 - Long-term average monthly rainfall (1981-2010)

14.16.13. Figure 14-8 shows the long-term average number of days that had rainfall over 10mm. It shows that for most of the year the River Severn catchment experiences fewer heavy rainfall days than its usual (average) for the UK.

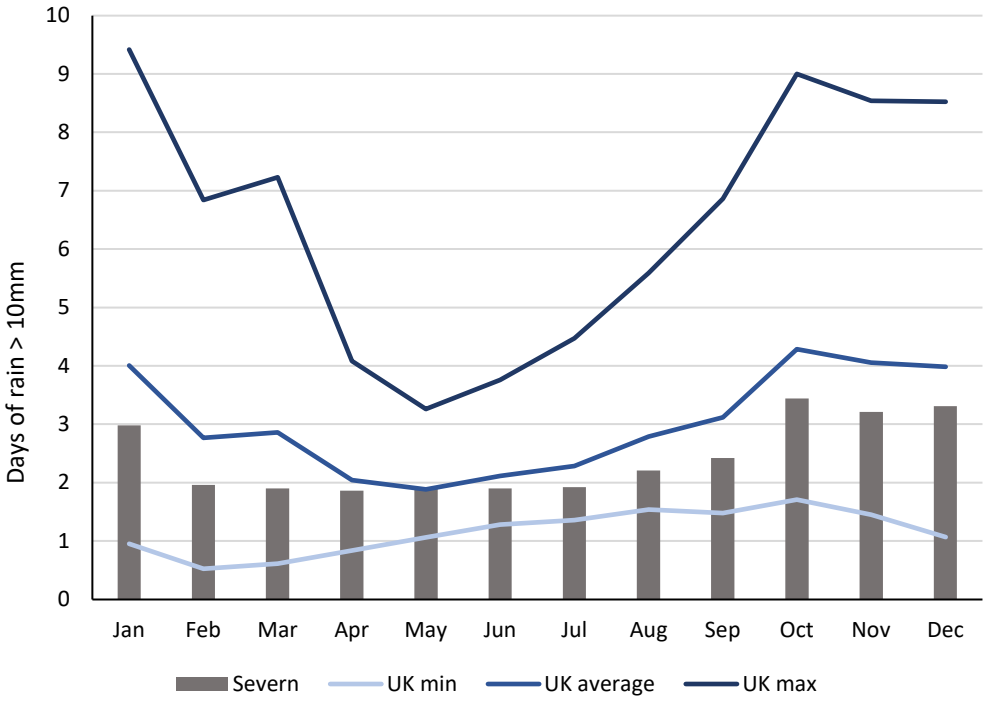

Figure 14-8 - Long-term average days with rainfall above 10mm (1981-2010)

14.16.14. Data from the Ross on Wye climate station shows that both summers and winters have variable precipitation and that rainfall in both these seasons has been increasing since 1930 (conclusion based on fit of linear trendline on Figure 14-9 and Figure 14-10).

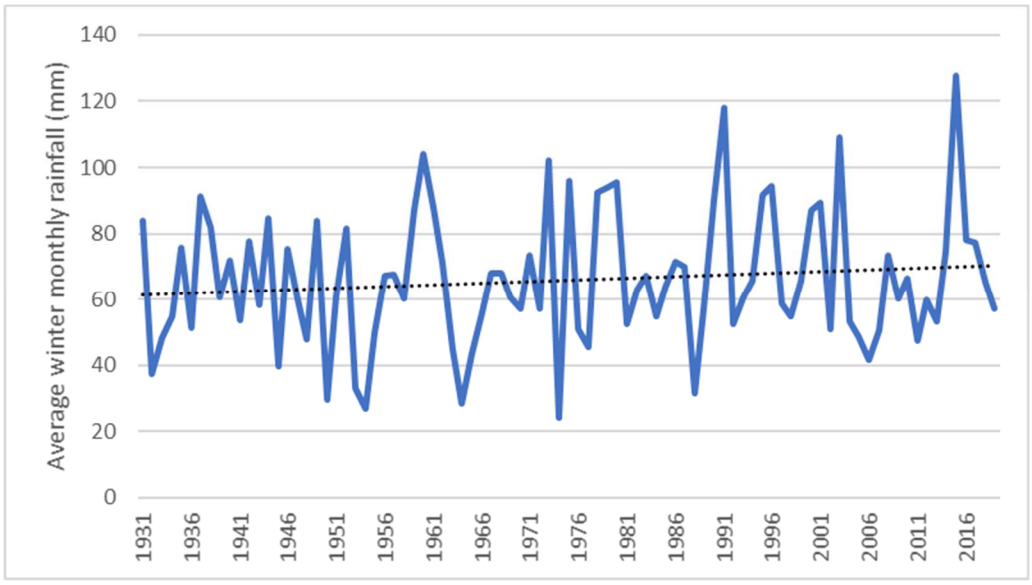

Figure 14-9 - Winter average monthly rainfall (mm) (1930-2019) (Ross-On-Wye)

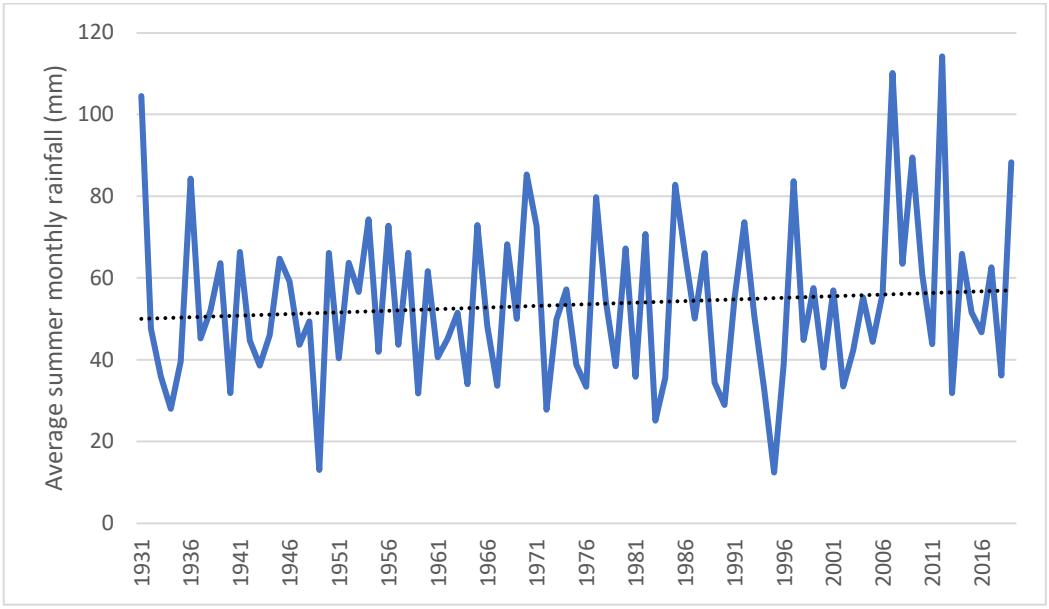

Figure 14-10 - Summer average monthly rainfall (mm) (1930-2019) (Ross-On-Wye)

14.16.15. Across the UK the amount of rain from extremely wet days has increased by 17% when comparing the period 2008-2017 to 1961-1990 period (Met Office, 2018). These changes are largest for Scotland and not significant for most of southern and eastern areas of England. Other extreme rainfall indices exhibit large inter-annual variability but are broadly consistent with increased rainfall over the UK. Other extreme rainfall indices exhibit large inter-annual variability but are broadly consistent with increased rainfall over the UK[121].

14.16.16. With regard to storminess, across the UK historical data provides no compelling trends as determined by maximum gust speeds from the UK wind network over the last four decades (UKCP18).

Projected future climate

14.16.17. This section presents the outputs of climate change models that cover the study area. In summary it finds that, on average, the UK is likely to experience hotter and drier summers and warmer, wetter winters. This is a widely agreed finding. Alongside these changes in

[121] http://research.ncl.ac.uk/convex/ [accessed 21st February 2018]

the average conditions, it is possible that climate change will also increase the frequency and severity of extreme weather events, such as heavy rainfall, storms and heatwaves.

14.16.18. The climate projections presented in this section are from UKCP18 (United Kingdom Climate Projections 2018). These projections have been developed by the Met Office Hadley Centre Climate Programme which is supported by the Department of Business, Energy and Industrial Strategy (BEIS) and the Department for Environment, Food and Rural Affairs (DEFRA). They provide the most up-to-date assessment of how the climate of the UK may change over the 21st century. The projections presented are for the River Severn catchment, within which the Scheme is located. The data is presented as averages for the period running from 2071 to 2089. For temperature and precipitation seasonal averages are provided for summer and winter, which represent the most extreme changes in response to climate change.

14.16.19. In accordance with LA114 the UKCP18 projections presented are for emissions scenario RCP8.5 (Relative Concentration Pathway 8.5). This is the most extreme emissions scenario, it represents a future where greenhouse gas emissions continue to rise, and the nations of the world choose not to switch to a low carbon future.

Temperature projections - warmer winters

14.16.20. Figure 14-11shows that under RCP8.5 average winter temperatures in the River Severn catchment are expected to increase from 4.1ºC (observed average 1981-2010) to 7.0ºC (projected average 2071-2089), an increase of 2.9ºC (based on the central estimate, i.e. 50th percentile). The uncertainty around this estimate of change ranges from 1.1ºC to 4.8ºC (represented by the 10th and 90th percentiles respectively).

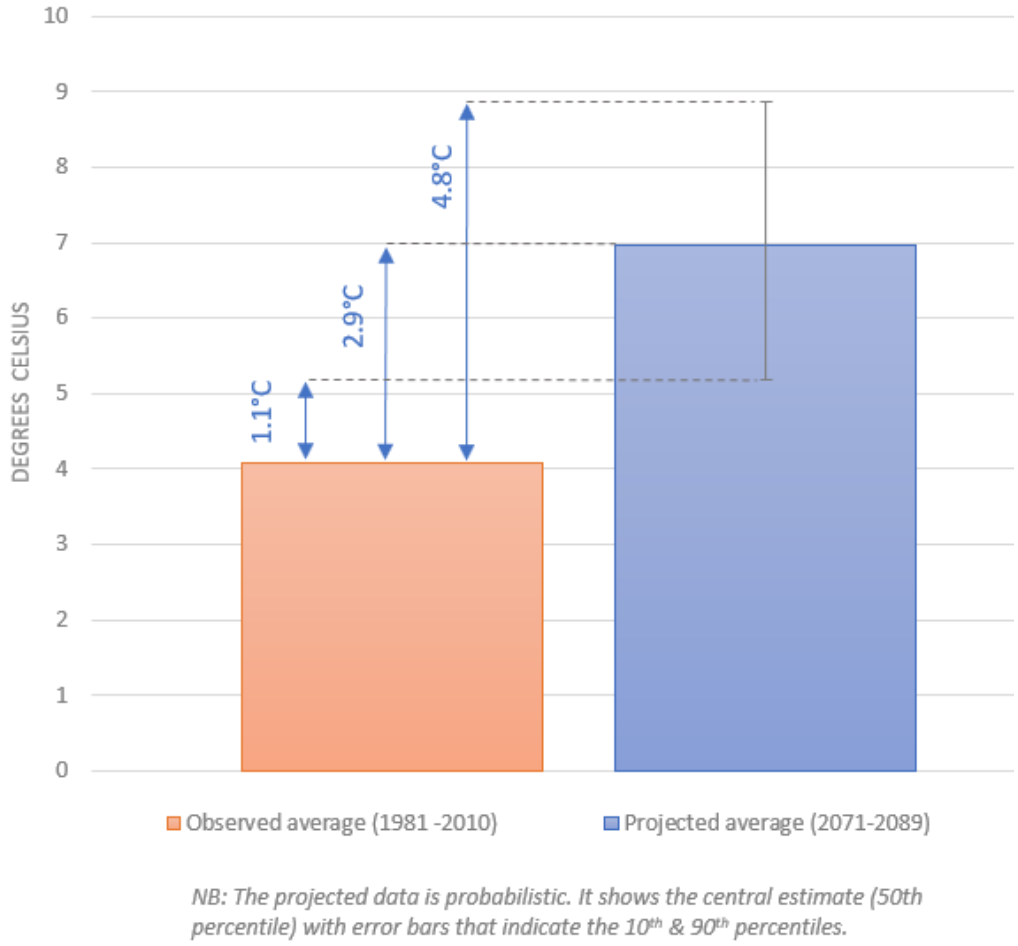

Figure 14-11 - Projected average mean winter temperatures (2071-2089)

14.16.21. In the UK, the heaviest snowfalls tend to occur when the air temperature is between zero and 2°C[122]. The projected increase in winter temperatures are therefore expected to reduce mean snowfall, number of snow days and heavy snow events[123]. While there is less certainty in the magnitude of these changes, there is confidence in the negative direction of the change[124]. This is supported by the fact that the decade leading up to the publication of UKCP18 (2008-2017) had 5% fewer days of air frost and 9% fewer days of ground frost compared to the 1981-2010 average, and 15% and 14% respectively compared to 1961-1990[125].

Temperature projections - hotter summers

14.16.22. In the recent past (1981-2000) the probability of seeing a summer as hot as 2018 in the UK was low (<10%). This probability has already increased due to climate change and is now estimated to be between 10-25%. With future warming, hot summers by the mid-century could become even more common (with probabilities of the order of 50% depending on the emissions scenario followed) [126].

14.16.23. In the River Severn catchment, within which the Scheme is located, projected mean daily maximum summer temperatures have been obtained from the UKCP18 probabilistic projections for 2071-89. Since these are an average of summer daily maximum temperatures it should be noted that some days in this period are likely to be hotter than the values indicated below. Figure 14-12 shows that an increase in summer temperatures is expected by the 2080s under RCP8.5. The central estimate (i.e. 50th percentile) projects an increase of 5.1ºC in summer mean daily maximum temperatures by 2071-89.

[122] Met Office. (2013). Met Office. [online] Available at: http://www.metoffice.gov.uk/learning/learn-about-the-weather/weather-phenomena
[123] Brown, S., Boorman, P. and Murphy, J. (2010). Interpretation and use of future snow projections from the 11member Met Office Regional Climate Model ensemble. UKCP09 Technical note, Met Office Hadley Centre, Exeter, UK
[124] McColl, L., Palin, E. J., Thornton, H. E., Sexton,·D. M. H., Betts, R. and Mylne, K. (2012). Assessing the potential impact of climate change on the UK's electricity network. Climatic Change, 115: 821-835. OR McColl, L., Angelini, T. and Betts, R. (2012) UK Climate Change Risk Assessment for the Energy Sector. Department for Environment Food and Rural Affairs, London, UK
[125] Met Office, (2019) UKCP18 Science Overview Report, online: https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Overview-report.pdf
[126] Met Office (2019) UKCP18 Science Overview Report, online, available: https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Overview-report.pdf

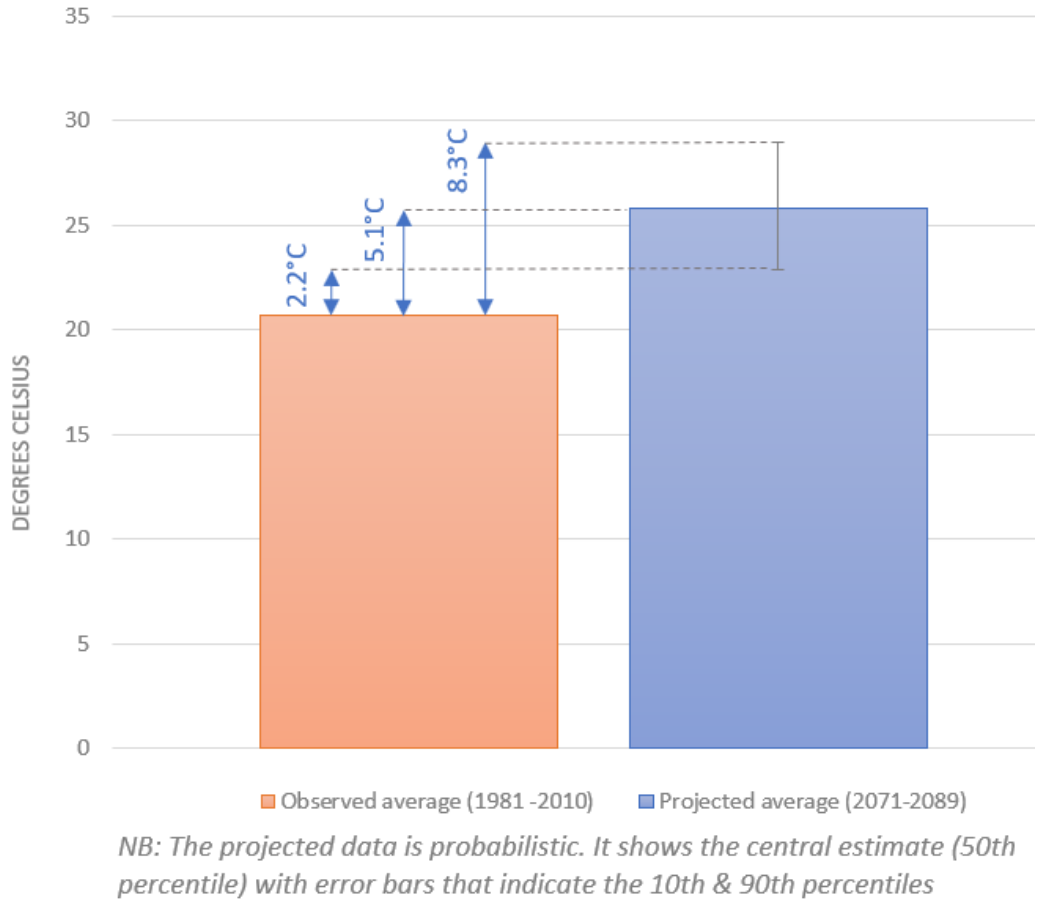

Figure 14-12 - Projected average maximum summer temperature (2071-2089)

Precipitation projections - drier summers

14.16.24. Projected precipitation levels for RCP 8.5 have been averaged across the River Severn catchment, within which the Scheme is located, to give a range of projected average rainfall change between the 10% and 90% probability levels. As shown in Figure 14-13 by 2071-89 this range amounts to a decrease in rainfall of between 0.1mm (7%) to 1.4mm (66%). The central estimate of change (i.e. 50th percentile) in mean summer precipitation for the same period is a 0.7mm reduction. These projections suggest that future average rainfall trends are uncertain, but it is more likely than not that summer rainfall will decrease. It is noted that historic observations recorded at the Ross-on-Wye climate station show average summer rainfall may have increased between 1930-2019 (see Figure 14-10). This supports the finding that future average rainfall trends are uncertain.

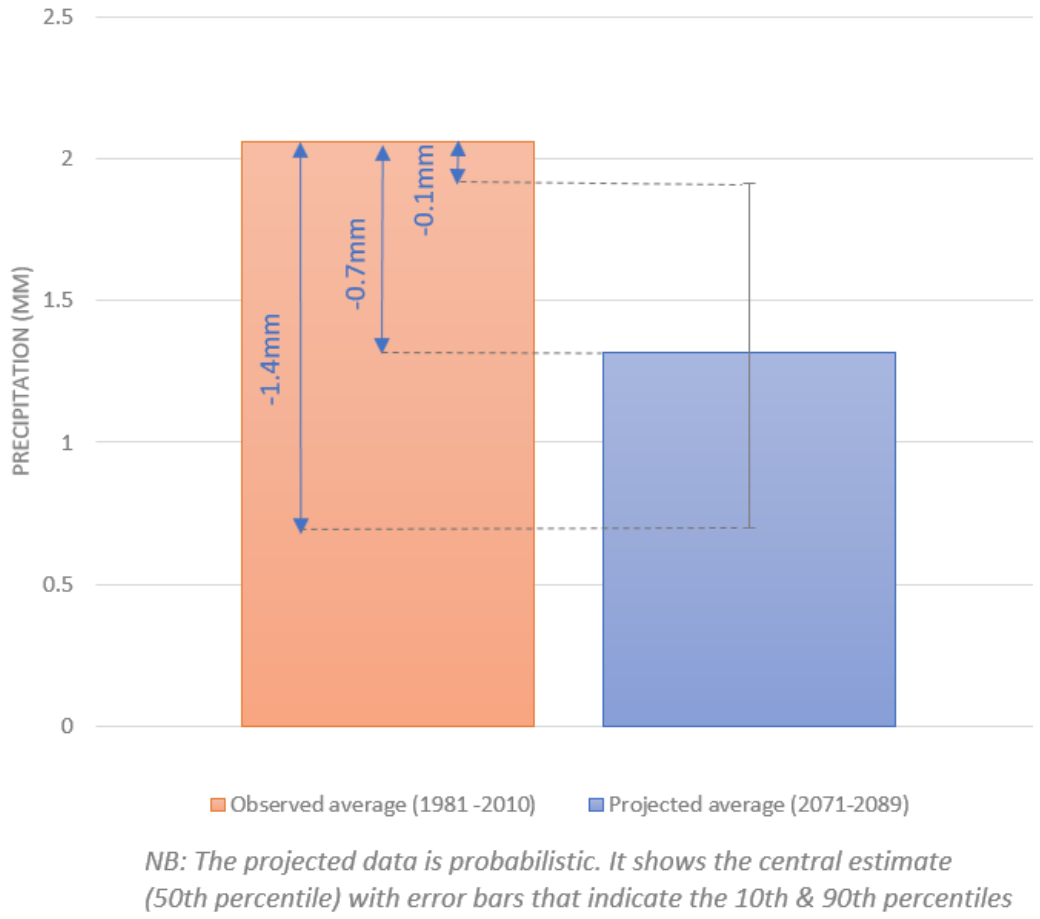

Figure 14-13 - Projected average summer precipitation (2071-2089)

Precipitation projections - heavier rainfall and wetter winters

14.16.25. shows that UKCP18 climate projections forecast that by 2071-89, under RCP8.5 central estimate (i.e. 50th percentile), winter mean precipitation will increase by 0.5mm. However, it should be noted that year to year levels are expected to continue to vary widely. This is demonstrated in the recent historical record in which the winters of 2013-14 and 2015-16 stand out as having particularly high amounts of rainfall (Figure 14-9), each with over 150% of the 1981-2010 average UK winter rainfall.

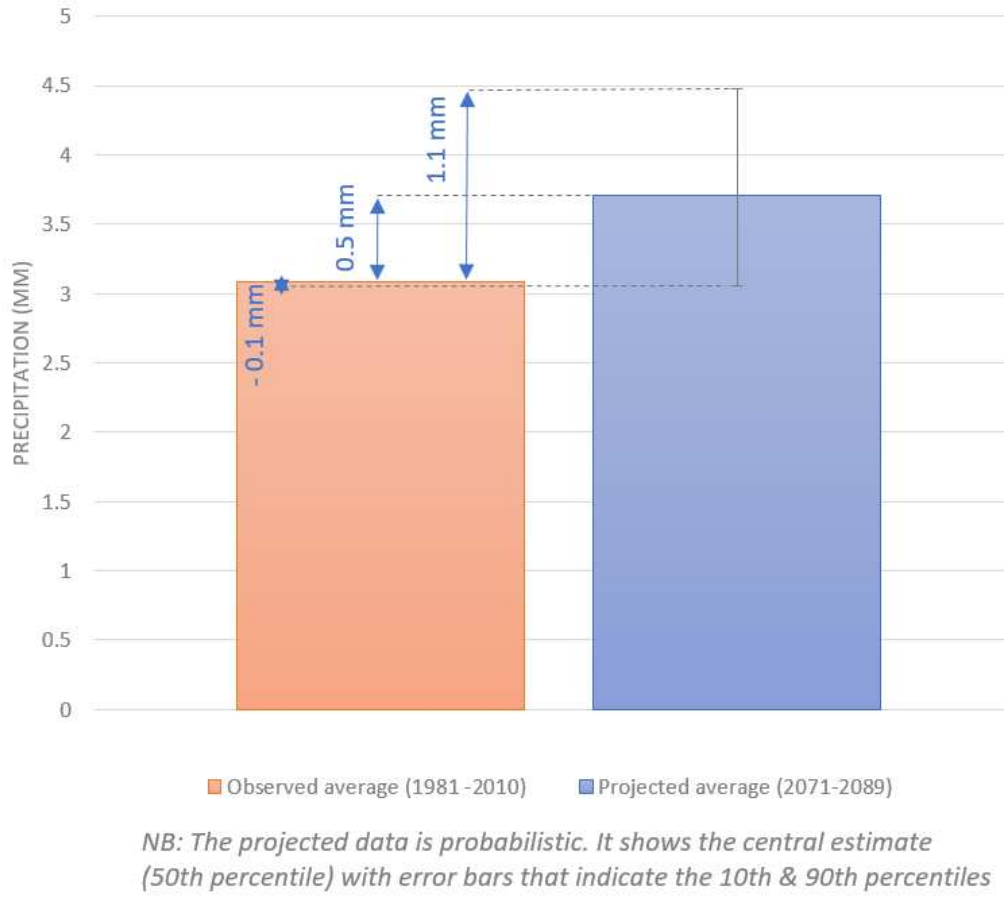

Figure 14-14 - Projected average winter precipitation (2071-2089)

14.16.26. Across the UK the amount of rain from extremely wet days has increased by 17% when comparing 2008-2017 with the 1961-1990 period[127]. Changes have been the largest for Scotland and are not significant for most of southern and eastern areas of England. Other extreme rainfall indices exhibit large inter-annual variability but are broadly consistent with increased rainfall over the UK.

Extreme weather projections

14.16.27. Future projections of storms and high winds are uncertain. They depict a wide spread of future changes in mean surface wind speed. This is partly due to large uncertainty in projected changes in circulation over the UK, and also because of wide ranging natural climate variability[128]. It is therefore difficult to represent extreme winds and gusts within regional climate models[129]. Global projections show an increase in near surface wind speeds over the UK for the second half of the 21st century for the winter season[130]. These studies suggest that climate-driven storm changes are less distinct in the Northern than Southern hemisphere[131]. There is some agreement of a projected poleward shift in storm tracks across the Atlantic Ocean. However, for mid-Atlantic storms, such as those that affected the UK in early 2014, projections are less certain[132]. Potentially, those mid-

[127] Met Office, UK extreme events, 2018, https://www.metoffice.gov.uk/research/climate/understanding-climate/uk-extreme-events- heavy-rainfall-and-floods
[128] Brown, S., Boorman, P., McDonald, R., and Murphy. J. (2012) Interpretation for use of surface wind speed projections from the 11-member Met Office Regional Climate Model ensemble. Post-launch technical documentation for UKCP09. Met Office Hadley Centre, Exeter, UK. Crown copyright
[129] Ibid
[130] Met Office, UKCP18 Factsheet: Wind, www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-fact-sheet-wind.pdf
[131] Bengtsson, L., Hodges, K. I. (2005). Storm Tracks and Climate Change. Journal of Climate, 19: 3518-3543. http://dx.doi.org/10.1175/JCLI3815.1
[132] Slingo, J., Belcher, S., Scaife, A., McCarthy, M., Saulter, A., McBeath, K., Jenkins, A., Huntingford, C., Marsh, T., Hannaford, J. and Parry, S. (2014).The recent storms and floods in the UK, Met Office, Exeter, 29pp

Atlantic storms may become more intense, particularly with the long-term warming of the sub-tropical Atlantic that could increase the amount of moisture that those storms carry[133]. However, such is the wide range of inter-model variation, robust projections of changes in storm tracks over the UK are not yet possible, and there is low confidence in the direction of future changes in the frequency, duration or intensity of storms affecting the UK.

14.17. Assumptions and limitations

14.17.1. The climate vulnerability assessment will provide a broad, high-level indication of the potential impacts of climate change on the Scheme based on professional judgement.

14.17.2. The climate projections used will be from UKCP18 (United Kingdom Climate Projections 2018). The UKCP18 projections do not provide a single precise prediction of how weather and climate will change years into the future. Instead UKCP18 provides ranges that aim to capture a spread of possible climate responses. This better represents the uncertainty of climate prediction science. It should also be noted that the level of uncertainty of the projections is dependent on the climate variable, for example, there is greater confidence around changes in temperature than there is in wind. In the climate vulnerability assessment this will be considered when assessing the likelihood of impacts.

14.17.3. The climate vulnerability assessment will be based on data from RCP 8.5. This is a greenhouse gas concentration trajectory under which it is assumed that emissions continue to rise throughout the 21st century. There is considerable uncertainty regarding if, how far and how quickly emissions will be reduced in the future. Using RCP 8.5 represents a conservative position.

14.17.4. Other key caveats and limitations of UKCP18 data are presented on the Met Office website[134].

14.18. Potential impacts

14.18.1. This section provides a preliminary high-level indication of the potential impacts of climate change on the Scheme that will be assessed in detail in the Scheme ES. It is based on professional judgement.

Potential construction impacts

14.18.2. The climate of the study area has already changed from its natural state, as a result of climate change. However, the Scheme's construction is not expected to be so far in the future that the climate will notably change further prior to construction. Climate change is therefore not expected to impact construction.

14.18.3. If construction coincides with extreme weather event(s) such as drought or storms there may potentially be construction impacts. It is proposed that these will be scoped out of further assessment. They would instead be managed through the CEMP and addressed as required by the relevant topics within the ES, for example potential construction related surface water flood risks related to extreme weather will be addressed within Chapter 8 Road Drainage and the Water Environment.

Potential operational impacts

14.18.4. Potential operational impacts on asset receptors (including their operation, maintenance and refurbishment):

- Road surfaces and pavements:
  - Warmer winters reduce winter maintenance and associated traffic disruption (less road salting and freeze thaw damage).
  - Hotter summers damage materials (rutting, shrinkage and expansion) increasing maintenance requirements and associated traffic disruption.

[133] Ibid
[134] www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-guidance---caveats-and-limitations.pdf

- Heavier rain and wetter winters cause pot holes (by weakening the soil beneath the carriageway) increasing maintenance requirements and associated traffic disruption.

- Structures (including embankments, earthworks and bridges):
- Hotter summers reduce the asset lives of structures (over expansion and buckling) increasing maintenance requirements and associated traffic disruption.
- Drier summers cause soil instability (intensify and extend soil moisture deficits and impact groundwater levels and earth pressures) increasing maintenance requirements and associated traffic disruption.

- Drainage infrastructure:
- Hotter temperatures dry out soils and so increases erosion. This causes sedimentation within the Scheme's drainage infrastructure and reduces its drainage capacity, therefore increasing the risk of flooding causing traffic disruption. Additional maintenance work to prevent flooding may also cause traffic disruption.
- Heavier rain and wetter winters increase the risk of pluvial or surface flooding. Flooding and additional maintenance requirements both cause traffic disruption.
- Milder winters reduce freeze thaw erosion which could damage underground assets, this reduces maintenance requirements and associated traffic disruption.

- Road technology and street furniture:
- Extreme weather impacts on electrical equipment include more regular lightning strikes and extreme hot temperatures causing thermal over loading of circuits. Repair and maintenance cause traffic disruption.
- High winds in more regular storms overload small structures and signage and damage roadside planting and furniture. Repair and maintenance cause traffic disruption.

- Landscaping:
- Drier summers damage the Scheme's landscaping. More regular maintenance causes traffic disruption.

14.18.5. Potential operational impacts on end-user receptors:

- Driver experience:
- Warmer winters improve winter driver safety and so reduce traffic disruption caused by accidents.
- Hotter summers increase vehicle breakdowns and so increase the traffic disruption they cause, and associated accidents.
- Hotter summers increase accident rates and so increase traffic disruption.
- More heavy rain and wetter winters reduce driver safety and so increase traffic disruption associated with accidents.
- Storms and high winds reduce driver safety and so increase traffic disruption associated with accidents.

14.18.6. Potential operational impacts on environmental receptors that are related to, or could be intensified by, climate change will be assessed as cumulative effects. These will be summarised in the climate vulnerability chapter and will be developed in parallel with the assessments for the other environmental topics. Examples of potential impacts on environmental receptors that may be included:

- Warmer winters reducing the requirement for road salting with benefits for water quality in nearby surface water bodies;
- Climate change is projected to make summers drier, with occasional heavy convectional rainfall. Water quality in nearby surface water bodies may, in the future, become more vulnerable to impacts from first flush events. This is when long periods of dry weather enable contaminants to build up on road surfaces, which then mobilise in surface water runoff following a heavy rainfall event and enter aquatic systems via surface water runoff and drainage infrastructure en-

masse. Pollutants in this runoff can be harmful to aquatic life;

- Hotter and drier summers may lower river water levels. In the future water quality impacts related to the Scheme's surface water drainage discharges could increase as the capability of these watercourses to dilute discharges reduces;
- Operational impacts on air quality from the Scheme's traffic emissions. In the future, impacts caused by the Scheme's vehicle emissions will be intensified as hotter summers brought on by climate change will increase the formation of ground-level ozone.

14.19. Potential effects and mitigation measures

14.19.1. An assessment of residual climate vulnerability impacts will be undertaken after consideration of the Scheme design and its embedded mitigation, which will be included in the design specifically to adapt the Scheme to be more resilient to climate change impacts. Embedded mitigation measures will be developed once further design information is available. Examples of possible embedded mitigation measures include best practice design and construction techniques, such as:

- Climate change allowances will be incorporated into the design of drainage infrastructure, flood compensation areas and river crossings/modifications;
- The use of polymer modified bitumen in surface course of pavements and heavy-duty macadam in the binder and base course to improve their resilience to rutting in hot weather;
- Embankments will be designed from slope-stability analysis using site specific soil parameters, and compacted and constructed in line with best practice to avoid unexpected ground movements, for example linked to long term changes in ground water levels);
- Sediment traps will prevent silt build up blocking drainage infrastructure;
- Protection of electrical equipment from lightning strikes using Surge Protection Devices;
- New safety infrastructure (technology) to mitigate possible future increases in exposure to dangerous driving conditions, for example more regular heavy rainfall events.

14.20. Likely residual effects

14.20.1. Climate projections from UKCP18 will be examined. It is expected that they will confirm that the climate in the study area is projected to change in the future. It is likely that the Scheme will be vulnerable to construction and operational impacts linked to these changes in the climate. Best practice construction methods and mitigation measures built into the design (i.e. embedded mitigation) that either avoids these impacts, minimises them or reduces their consequences will be presented. After consideration of these mitigations it is expected that none of the potential climate vulnerability impacts will be found to be significantly adverse. This conclusion will be confirmed by the detailed climate vulnerability assessment.

14.21. Proposed level and scope of assessment

14.21.1. The scoping assessment shall identify whether anticipated changing climate conditions and extreme weather events are likely to have significant adverse effects on the Scheme during construction and operation.

14.21.2. Potential impacts on environmental receptors that could be intensified by climate change will be assessed as cumulative effects.

14.21.3. This report focuses on identification of potentially significant climate changes and the likely Scheme exposure to these changes. It also identies vulnerable elements of the Scheme that require further assessment.

14.22. Proposed assessment methodology

14.22.1. Where the climate change impact on project receptors is potentially significant, a risk assessment shall be undertaken. The method for this assessment is set out in this section. It follows guidance set out in DMRB, Volume 11, Section 3, Part 14 Climate: LA114[135] and will be informed by best practice climate assessment approaches and literature, as well as professional judgement.

14.22.2. There are four stages to the climate vulnerability assessment method:

- Stage 1 - Identify the receptors.
- Stage 2 - Assess the likelihood of impacts on each receptor.
- Stage 3 - Assess the consequence of impacts for each receptor.
- Stage 4 - Determine the significance of each impact based on a combination of the likelihood of an impact occurring and the consequences of that impact.

Stage 1 - Identification of receptors

14.22.3. Receptors which may be affected by climate change have been identified with consideration of both extreme weather events and gradual climatic changes in the study area over the Scheme's design life. In accordance with LA 114 the assessment will consider impacts on the following receptors:

- Construction process (including workforce, plant, machinery etc.).
- The assets and their operation, maintenance and refurbishment (including: pavements, structures, earthworks, drainage and technology assets such as signs, signals and traffic sensors).
- End-users (nearby residential properties, members of the public, commercial operators, road user safety and experience).

14.22.4. Where it is not already covered in the relevant topic chapters consequential loss or damage to environmental receptors as a result of the Scheme's vulnerability to climate change will be discussed in the cumulative effects section of the chapter.

Stage 2 - Assess the likelihood of impacts

14.22.5. In accordance with LA114 the likelihood of potential climate changes and events occurring will be determined using available data (such as the known recurrence interval of extreme weather events) and professional judgement. The likelihood categories and associated frequencies are provided in Table 14-5.

Table 14-5 - Likelihood categories

Likelihood category	Description (probability and frequency of occurrence)
Very high likelihood	The impact occurs multiple times during the lifetime of the project (60 years) e.g. approximately annually, typically 60 events.
High likelihood	The impact occurs several times during the lifetime of the project (60 years) e.g. approximately once every five years, typically 12 events.
Medium likelihood	The impact occurs limited times during the lifetime of the project (60 years) e.g. approximately once every 15 years, typically 4 events.
Low likelihood	The impact occurs once during the lifetime of the project (60 years) e.g. once in 60 years.
Very low likelihood	The impact may occur once during the lifetime of the project (60 years).
Table Notes: Project lifetime is considered to include construction and operational phases; project lifetime is taken to be 60 years in line with LA114 guidance and WebTAG	

[135] https://www.standardsforhighways.co.uk/prod/attachments/87f12e4f-70f8-4eed-8aed-9e9a42e24183

Likelihood category	Description (probability and frequency of occurrence)
Table Source: DMRB, Volume 11, Section 3, Part 14 Climate: LA114 (Oct, 2019)	

Stage 3 – Assess the consequence of impacts

14.22.6. The consequence of climate change impacts on the Scheme receptors will be categorised using the criteria in Table 14-6.

Table 14-6 - Consequence categories

Consequence of impact	Example description
Very large adverse	National level (or greater) disruption to strategic route(s) lasting more than 1 week.
Large adverse	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	Regional level disruption to strategic route(s) lasting more than 1 day but less than 1 week.
Minor adverse	Regional level disruption to strategic route(s) lasting less than 1 day.
Negligible	Disruption to an isolated section of a strategic route lasting less than 1 day.
Minor beneficial	Reduction in regional level disruption to strategic route(s) lasting less than 1 day.

Table Source: DMRB, Volume 11, Section 3, Part 14 Climate: LA114 (Oct, 2019)

Stage 4 - Determine significance of impacts

14.22.7. The results of the likelihood and consequence assessments will be combined to derive a significance classification as outlined in Table 14-7.

Table 14-7 - Significance matrix

Impact consequence	Impact likelihood				
	Very low	Low	Medium	High	Very high
Negligible	NS	NS	NS	NS	NS
Minor	NS	NS	NS	NS	NS
Moderate	NS	NS	S	S	S
Large	NS	NS	S	S	S
Very large	NS	S	S	S	S
Table notes: *NS = Not Significant, S = Significant* *Impacts can be adverse or beneficial.*					

14.22.8. The assessment will be undertaken with consideration of the Scheme design and embedded mitigation. Where mitigation in addition to embedded mitgiation in the design is required, i.e. additional measures to reduce otherwise significant impacts, these will be presented in the residual effects section prior to reassessment of the impacts significance. If residual (non-significant) cumulative effects remain in the environmental assessment then measures to manage the ongoing risks will be identified.

14.23. Vulnerability to major accident and disasters

14.23.1. The climate vulnerability assessment will include consideration of the Scheme's vulnerability to major extreme weather events. This will include consideration of the magnitude of historic observed extreme events as well as examination of extreme, 90th percentile, UKCP projections.

14.24. Proposed consultation

14.24.1. No specific consultation is proposed with regard to the Scheme's vulnerability to climate change.

14.24.2. In relation to flood risk and drainage design, NPPF 2019 planning requirements and Environment Agency design guidance relating to climate change apply. Therefore, a separate flood risk assessment will be conducted, which will include an assessment of climate change effects on flood risk, taking into account current Environment Agency climate change allowances for increases in peak river flow and rainfall intensity. A summary of the consultation on and results of these assessments will be presented in the ES climate vulnerability chapter.

14.25. Conclusion

14.25.1. An assessment of the Scheme's vulnerability to climate change will be carried out, in accordance with LA 114 guidance. The proposed scope of the assessment is summarised in Table 14-8 below.

Table 14-8 - Summary of proposed scope of climate vulnerability assessment

Impact	Scoped In / Out	Comments
Potential impacts on construction process (including workforce, plant, machinery etc.)	Out	Managed through the CEMP and addressed as required by the relevant topics within the ES, for example potential construction related surface water flood risks related to extreme weather will be addressed within the Road Drainage and the Water Environment (Chapter 8).
Potential operational impacts on assets and their operation, maintenance and refurbishment.	In	This will include impacts on the following receptors: pavements, structures, earthworks, drainage and technology assets such as signs, signals and traffic sensors.
Potential operational impacts on end-user receptors	In	-
Potential operational impacts on environmental receptors (cumulative effects)	In	-

15. Cumulative Impact Assessment

15.1. Introduction

15.1.1. This Chapter provides the legislative and policy context for consideration of cumulative impacts and presents the definition of cumulative effects that will be used in producing the ES for the Scheme. The proposed scope for the cumulative impact assessment (CIA) is described, together with the approach to be adopted in identifying and reporting on cumulative effects within the ES, which has been developed with reference to the relevant parts of DMRB LA104. The chapter includes the criteria used in generating an initial long-list of RFFP that could potentially interact with the Scheme to give rise to cumulative effects for certain receptors. The methodology that will be used in refining this from a long list to a short list of RFFPs for assessment within the ES is also included.

15.1.2. No CIA is undertaken as part of this Scoping Report due to the design phase in which it is being prepared.

15.2. Planning policy and topic legislative context

15.2.1. Paragraph 5 of Schedule 4 to the EIA Regulations 2017 requires an ES to include the assessment of cumulative effects. In accordance with the guidance within DMRB LA 104, the environmental effects of the Scheme will also be assessed as part of the EIA process, exploring cumulative effects across topics and upon receptors where the effects of the Scheme may act in combination with the effects of other developments, where relevant information is available.

15.2.2. Beyond the reference to “existing and/or approved” projects in paragraph 5, what developments should be considered as part of a 'cumulative' assessment for these purposes is not defined in the EIA Directive or EIA Regulations 2017 and there is no standard approach to the assessment of cumulative effects, with different projects adopting different approaches. However, potential cumulative impacts with other major developments need to be identified, as required by the Directive. To aid in this, the PINS Advice Note 17 suggests the categories of developments that should be included in such cumulative assessments. DMRB LA 104 also addresses the assessment of cumulative effects and states that the assessment should include roads projects that have been confirmed for delivery over a similar timeframe; other development projects with valid planning permissions or consent orders, and for which EIA is a requirement; and proposals in adopted development plans with a clear identified programme for delivery.

15.2.3. For the purposes of CIA, consideration must be given to consented development in the vicinity of the Scheme, as well as planned future housing and empoyment growth levels and general locations. This information is collated from planning application databases, the Planning Inspectorate (for relevant NSIPs) and adopted planning policy. It is drawn together into a list of RFFPs, to generate a future spatial baseline scenario from which to assess the implications for and from the Scheme in relation to anticipated future development (i.e. RFFPs).

15.3. Proposed level and scope of assessment

15.3.1. In the ES, the CIA will explore the way in which the predicted effects of the Scheme on receptors/resources may alter when they are considered in their totality (i.e. across all topic assessments), as well as in the context of RFFPs, that could potentially interact with the Scheme. DMRB LA 104 provides a definition of cumulative effects that reflects these two potential sources of cumulative impacts for consideration within CIA – for the purposes of this Scoping Report, they are referred to as intra-Scheme assessment and inter-project assessment, as introduced in Chapter 4 of this Scoping Report:

- Intra-Scheme assessment – cumulative impacts arising within this Scheme.
- Inter-project assessment – cumulative impacts arising between the Scheme and

other developments expected to come forward within similar timeframes. This is completed with reference to the RFFPs – Table 15-1 provides an initial long-list (dated October 2020).

Reporting

15.3.2. It is anticipated that within the ES, topic chapters will report on individual receptors/resources predicted to experience multiple topic-specific effects and comment on their likely significance (i.e. intra-Scheme cumulative effects within a specialist topic). Individual topic chapters will identify which of the RFFPs are considered relevant to the assessment. Where inter-project cumulative effects are predicted in relation to an environmental topic, these are to be reported within the topic chapters, providing an indication of potential significance.

15.3.3. A separate CIA summary section would then be produced. This will report on intra-Scheme cumulative effects that have been identified for receptors/resources predicted to experience significant effects either within an environmental topic, and/ or in relation to more than one environmental topic (referred to as 'cross-topic'). This summary sections would also, if necessary, address inter-project effects that have been identified for receptors/resources predicted to experience significant effects from the Scheme and at least one RFFP, either within an environmental topic, and/or in relation to more than one environmental topic (referred to as 'cross-topic').

Types of cumulative impacts

15.3.4. The CIA for the Scheme will consider effects arising from additive impacts that could be caused by other past, present or reasonably foreseeable actions interacting with the Scheme; and effects arising from in-combination impacts that arise from the interaction between impacts of a Scheme on different aspects of the environment.

Cumulative impacts – additive

15.3.5. This is where the same impact is multiplied on the basis that it arises from more than one source. This is illustrated below:

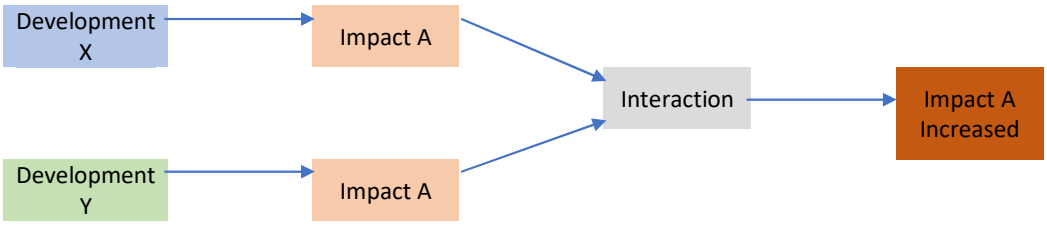

Figure 15-1 - Additive cumulative effects

15.3.6. This additive type of cumulative impact is most likely to arise in an assessment of inter-project effects. It has the potential to raise the level of impact above assessment or regulatory thresholds, even though each development has been designed not to.

Example

15.3.7. Construction noise (impact A) of the Scheme ('development X') and the construction noise associated with an adjacent RFFP ('development Y') combines to increase the noise impact (impact A) on a group of residential properties.

Cumulative impacts – in-combination

15.3.8. This is where two different impacts interact to create a third impact. These two impacts may arise within the same environmental topic area; or arise within two or more different environmental topic areas. The issue is that the third impact is more than or different from just the first two impacts occurring together. This is illustrated below:

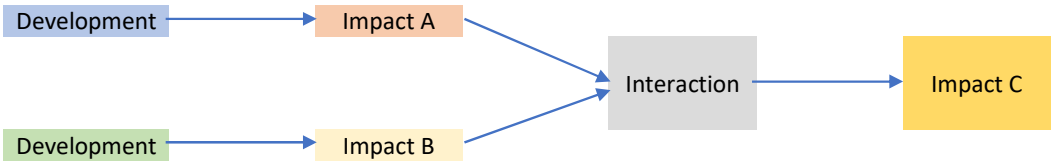

Figure 15-2 - in-combination cumulative effects

15.3.9. This type of in-combination impact could arise in consideration of both inter-project and intra-Scheme CIA. It is usually (but not always) the case that reporting of effects arising from in-combination impacts is easiest to understand when it is organised by receptor and/or biophysical feature, rather than within environmental topic chapters.

Example:

15.3.10. Construction noise (impact A) and construction dust emissions (impact B) associated with the Scheme, combine to create an amenity impact (impact C) on a group of residential properties.

Cumulative impact assessment scope

15.3.11. The CIA for the Scheme will encompass consideration of the following types of impacts:

- Intra-Scheme **in-combination** cumulative impacts, within specialist topic chapters – construction and operation considered separately
- Intra-Scheme **in-combination** cumulative impacts, drawing together findings across the topic chapters – construction and operation considered separately
- Inter-project **additive** cumulative impacts – these will cover construction and operation separately and be considered firstly within relevant specialist topics and, if relevant, cross-topic
- Inter-project **in-combination** cumulative impacts – these will cover construction and operation separately and be considered firstly within relevant specialist topics and, if relevant, cross-topic

15.3.12. The findings of the specialist topic assessment of **significant intra-Scheme cumulative effects** and **significant inter-project cumulative effects** informs the identification of the cross-topic effects. This is achieved by correlating the reported impacts to individual receptors and/or biophysical features and considering the implications of overlapping effects. The ES will include a summary table of intra-Scheme effects cross-topic, by receptor and/or biophysical feature and, for inter-project effects, by relevant RFFP.

15.3.13. Intra-Scheme additive cumulative impacts will also be included within the ES, for example, through the provision of total physical impacts of land take on specific resources and/or biophysical features. However, this type of reporting is an inherent characteristic of certain topic chapters (e.g. total loss of best and most versatile agricultural land, as part of the geology and soils assessment topic). It is therefore not drawn out separately.

15.4. Proposed assessment methodology

15.4.1. The future baseline environment comprises the existing baseline, together with new or changed characteristics and conditions that can reasonably be predicted to be present during construction and/or operation of the Scheme. These characteristics are derived from the short-list of RFFPs, which will be developed from a review and refinement of the long-list provided in Table 15-1 and published within the ES.

15.4.2. There are two main contributing elements in the definition of the future baselines that will be considered within the ES:

- RFFPs sourced from a search of relevant planning applications, development consent order (DCO) applications, Transport and Works Act Order applications and proposed development contained within relevant Development Plan documents.; and

- forecast changes in traffic conditions projected within local authority traffic forecast models. Further details about this will be referenced in the air quality and noise and vibration topic chapters of the ES, which will draw on traffic modelling outputs.

15.4.3. The CIA will make use of two future baselines for the Scheme to be considered against, making informed assumptions to categorise the likely progression of RFFPs, for the purposes of consistent assessment:

- Opening year future baseline (2025): RFFPs may be categorised as 'undeveloped'; 'under construction' in the same timeframe as the opening of the Scheme; or form new 'receptors/resources' that would be in place and operational in the same timeframe as the opening of the Scheme.
- Operational future baseline (2039): RFFPs may be anticipated to be 'under construction' in the same timeframe as the future baseline; or form new 'receptors/resources' that would be in place and operational.

15.4.4. The consideration of the cumulative impacts is drawn together on the basis of receptors and/or biophysical features deemed likely to experience effects as a consequence of cumulative impacts, whether intra-Scheme or inter-project or, potentially, both. The sensitivity of a receptor or biophysical feature to cumulative impacts and the magnitude of incremental impacts (combining to become cumulative impacts) themselves will determine the significance of the cumulative effect or effects.

15.4.5. This section provides a basic introduction to the way CIA will be approached and reported within the ES for the Scheme.

Approach to intra-Scheme cumulative impact assessment

15.4.6. The topic chapters each define a specialist assessment methodology, which results in differing approaches to drawing out the significant intra-Scheme effects. In some instances, such as the cultural heritage assessment and the assessment of effects on farm holdings, methodologies incorporate the consideration of in-combination intra-Scheme cumulative impacts as an inherent part of drawing conclusions about the type, magnitude and potential significance of effects within the main assessment. In such instances, the cumulative impact assessment section of the topic chapter signposts which of the significant effects noted in the main assessment findings are due to in-combination cumulative effects, rather than repeating or incorporating additional assessment work. This information will then be summarised in the CIA chapter of the ES.

15.4.7. There are also topics where the methodologies reference adherence to specific legislation or best practice that require all projects to incorporate design or control measures to ensure significant adverse effects are prevented, such as air quality assessment. In these cases, the cumulative impact assessment section of the topic chapter references receptors and/or biophysical features for which more stringent control measures (for example, controls on construction activities written into an Emvironmental Management Plan or similar document) are considered necessary as a reflection of receptors that, in the absence of such controls (a form of mitigation), would potentially experience significant intra-Scheme in-combination effects.

15.4.8. The cumulative impact assessment findings also draw on environmental design measures and mitigation proposals that have been developed from the iterative process of assessment and design, as a means of highlighting how the Scheme has evolved to address intra-Scheme impacts, in accordance with the mitigation hierarchy (see Chapter 4). For example, ecological mitigation areas targeting more than one species are designed to address intra-Scheme cumulative impacts identified through the ecological assessment that would, in the absence of the proposals, give rise to potentially significant cumulative effects. Similarly, combined landscape and environmental design measures target locations where, in the absence of the proposals, intra-Scheme cumulative effects on ecological and landscape biophysical resources may potentially be significant.

15.4.9. The cross-topic intra-Scheme cumulative impact assessment is to be described in a receptor-centric manner, focusing on common receptor types and/or geographic locations where at least two different types of impacts are predicted to interact to result in significant

cumulative effects. The ES structure will be developed to allow for separate sections for the cumulative impact assessment to be written up within the specialist topic chapters, to facilitate this approach.

Approach to inter-project cumulative impact assessment

15.4.10. Central to the identification of inter-project cumulative impact assessment is an understanding of what projects are likely to come forward within timeframes that overlap with either the construction or operational phase of the Scheme. This is the purpose of generating the RFFP list for the Scheme, as described in Section 15.5.

15.5. Identification of RFFPs

15.5.1. RFFPs are projects that are known to the planning system or already in the consenting process or under construction at the same time as the Scheme. The definition applied to this Scheme has been developed in consideration of the guidance within DMRB LA 104, but also extended to encapsulate additional project types, which is based on consideration of potential 'zones of influence' for different environmental aspects, reflecting the approach proposed within PINS Advice Note 17. The RFFP long-list captures all projects that fall into one of the following categories:

- major planning applications within 500 m of the Scheme. This encompasses planning applications for 10 or more dwellings, planning applications incorporating commercial/recreational floorspace over 1,000 sqm, or a site exceeding 1 ha;
- planning applications adjacent or within 250m of the Scheme that have been granted planning permission or are pending determination since 01/10/2017, reflecting the 3-year period within which granted developments must commence works (at the point at which the RFFP long list is first produced);
- proposals registered with the Planning Inspectorate as forthcoming applications for Development Consent Orders. Professional judgement has been used to determine which are of relevance to the Scheme in the context of possible cumulative impacts, using proximity to the Scheme as a key consideration;
- registered Transport and Works Act Order applications near to the Scheme; and
- Development Plan projects such as site allocations and transport initiatives scheduled for development prior to 2025 (future operational baseline) that are within 500 m of the Scheme, subject to desk-based validation of sufficient evidence available relating to the projects to allow a meaningful cumulative impact assessment for the Project.

15.5.2. The first iteration of the RFFP long-list for the Scheme was produced in October 2020 considering planning applications, adopted and emerging Development Plan policies and allocations. At least one review will be carried out as the ES is produced. This reflects the cyclical approach to compiling the long and short lists of 'other existing development and/or approved development' set out within the PINS Advice Note 17 four-staged approach to undertaking what it terms 'cumulative effects assessment' (CEA). This review process (representative of stages 1 and 2 of the PINS CEA approach) will comprise a desk-based screening exercise to identify whether any of the RFFP long-list projects have already been constructed; and determine whether anything needs to be added. These will then be updated and shared with relevant stakeholders for confirmation, prior to refinement into a short-list, noting that the constructed projects would need to be included in the description of the existing baseline (as updated for the ES), to feature as receptors for consideration in the main EIA.

15.5.3. This Scoping Report is being used as an opportunity to consult on the methodology proposed to produce the RFFP long list and subsequently refine it to form a shortlist of RFFPs for consideration in the EIA and reporting in the ES.

RFFP Shortlisting

15.5.4. As the EIA progresses, the RFFP long-list will be screened in order to produce an RFFP shortlist for the CIA. This screening will be undertake by each of the topic specialists with

the aim of indetifying those developments that have reasonable potential to interact with the Scheme in respect of their topic and, therefore, potentially give rise to impacts that could result in cumulative effects.

15.5.5. The methodology and consideration that will be applied by each topic to complete the screening exercise will be set out in the CIA sections of each topic chapter in the ES, supported by a screening appendix if appropriate. This will typically be based on a combination of development type, proximity and the likelihood of impact pathways between the Scheme and the RFFP for the topic under consideration. The consideration of impact pathways usually allows for mandatory regulatory/legislative requirements that all developers must meet, for example, air quality control measures that would essentially negate risks of impact interactions between the Scheme and RFFPs.

15.5.6. RFFPs are screened out where the likelihood of interactions with the Scheme is extremely low/negligible. Where appropriate, specialists will then complete a scoping exercise to exclude detailed consideration of RFFPs where there is a robust justification for assuming that cumulative impacts would not occur between the Scheme and the RFFP – this will also be set out in individual topic chapters in the ES. This approach will assist in tightening the scope of the consideration of RFFPs and specialist topic assessment to cumulative impacts that bring meaningful inputs to the overall ES findings, delivering a proportional assessment that focuses on the potential for significant inter-project cumulative effects.

15.5.7. The screening and scoping process will allow an RFFP shortlist to be produced. This will be consulted upon and agreed with relevant stakeholders prior to incorporation within the EIA process.

15.5.8. For each short-listed RFFP, progression through the consenting and development processes will be reviewed drawing on publicly available information and comments from stakeholder consultation. Assumptions will be made about the most likely stage of their development in relation to the Scheme construction baseline (2024); and future (operational) baseline (2039), with each RFFP assigned to one of the following categories to inform the completion of the inter-project cumulative impact assessment work:

- Construction baseline - 'undeveloped site', which is used for a site at which construction is not expected to commence until the Scheme is operational
- Construction baseline - 'under construction' in same timeframe as the Scheme, reflecting at least a partial overlap in construction timeframes
- Construction baseline - 'receptor', which is used for a site where construction is not believed to have commenced (as at the fix point of the RFFP shortlist production – expected 2021), but is expected to be complete prior to the start of construction of the Scheme
- Future baseline - 'under construction' as the Scheme commences operation
- Future baseline - 'receptor', which is used for a site where development will be complete and in occupation, therefore forming a receptor and/or biophysical feature for the operational Scheme and, possibly, having potential to experience operational impacts from the Scheme

15.6. Assumptions and limitations

15.6.1. The CIA process proposed is qualitative. The following assumptions relate to the identifcation of potentially significant cumulative effects:

- The starting point for consideration of cross-topic intra-Scheme cumulative impacts is receptor centric – receptors are only considered where two or more potentially significant effects have been noted. The CIA then explores the full range of impacts on that receptor, irrespective of their assessed significance
- The starting point for consideration of inter-project cumulative impacts is where potentially significant effects are noted from the Scheme assessment, requiring mitigation. This allows for the CIA to explore whether the nature of interactions with impacts from RFFPs may give rise to suggestions that alternative mitigation or enhancement measures could deliver broader benefits

15.6.2. The consideration of inter-project cumulative impacts is limited by the availability, quality and level of detail publicly accessible data relating to RFFPs. This confers the following limitations to the assessment:

- RFFP lists cannot capture development proposals that have no formal recognised planning status
- CIA is based on publicly available information only – there is no intention to liaise directly with promoters of RFFPs
- An RFFP will be screened out of CIA where there is insufficient information available for meaningful assessment

15.6.3. Should the CIA process identify the potential for significant cumulative effects to arise, then consideration will be given to ways in which the Scheme could contribute towards mitigating such effects and the means by which this would be delivered. However, the limitations stated within paragraphs 3.4.10 – 3.4.12 of PINS Advice Note 17 apply, particularly where it may become relevant to consider the apportionment of causality for the cumulative effects identified between the Scheme and one or more other projects. The role and potential of collaborative approaches to developing cumulative effects mitigation strategies is therefore noted and, should this become necessary, the Scheme promoter will seek to develop appropriate proposals in consultation with other applicants and relevant consultation bodies.

Table 15-1 - RFFP List

Location	Reference	Description	Distance to Scheme Centreline
Adjacent to the north-western edge of Cheltenham	Policy A4 - North West Cheltenham	Approximately 4,285 new homes; A 10 hectare B-class office park. 13 hectares of predominantly non B-Class employment generating land	1 km
Adjacent to the urban edge of Cheltenham	Policy A7 – West Cheltenham	Approximately 1,100 new homes; Approximately 45 hectares of B-class led employment land	Adjacent
South of Churchdown and Innsworth	Policy A2 - South Churchdown	Approximately 1,100 new homes	4.4 km
North of Gloucester	Policy A1 - Innsworth & Twigworth	Approximately 2,295 new homes; Approximately 9 hectares of employment generating land	4.9 km
Old Gloucester Road	Policy HD8: Old Gloucester Road	Approximately 175 dwellings	Adjacent
Brockhampton Lane	Policy HD6: Brockhampton Lane	Approximately 20 dwellings	1.2 km
Christ College Site B	Policy HD1: Christ College Site B	Approximately 70 dwellings	1.8 km
Former Monkscroft Primary School	Policy HD2: Former Monkscroft Primary School	Approximately 60 dwellings	1.8 km
Land at Stone Crescent	Policy HD5: Land at Stone Crescent	Approximately 20 dwellings	1.3 km
Wingmoor Farm East, Orchard Rd, Bishops Cleeve, Cheltenham GL52 7DG, United Kingdom	1-Core Policy WCS6-Wingmoor Farm East	Wingmoor Farm East landfill, recycling and quarry complex	2.6 km
Unit 6, The Aerodrome, Stoke Rd, Cheltenham GL52 7RS, United Kingdom	2-Core Policy WCS6-The Park	Mixture of waste-related and other industrial type activities. It consists of former airplane hangars converted to industrial units.	2.1 km
Lowdilow Ln, Cheltenham GL52 7RS, United Kingdom	3-Core Policy WCS6-Wingmoor Farm West	Household Recycling Centre and is situated within a larger area permitted for landfilling operations	2.3 km

Location	Reference	Description	Distance to Scheme Centreline
Part Parcel 8227 Tewkesbury Road Elmstone Hardwicke Cheltenham Gloucestershire	16/00579/FUL; 16/00323/FUL; 15/01126/FUL	Erection of two buildings for Industrial/Factory development (Use Classes B1(c), B2 and B8) with ancillary offices (Use Class B1(a)) together with associated access road, landscaping, drainage ponds, car and cycle parking, service yards and access to Tewkesbury Road (A4019) and improvements to junction with Stoke Road.	435 m
Warners Of Cheltenham Blaisdon Way Cheltenham Gloucestershire GL51 0WH	15/00578/OUT	Outline application for the redevelopment of land at the junction of Blaisdon Way and Pilgrove Way for residential use with indicative layout of 10 dwellings and including removal of car wash facility (approval sought for means of access with other matters reserved)	330 m
Cotswold BMW Tewkesbury Road Cheltenham Gloucestershire GL51 9SG	17/00936/FUL	Full planning application for erection of 2,856 sq.m food store (Use Class A1) and 223 sq.m of coffee shop retail and drive-thru (Use Class A1/A3) with associated landscaping, parking and infrastructure	350 m
M And S Home Unit 10 Kingsditch Retail Park Tewkesbury Road Cheltenham Gloucestershire GL51 9PG	17/01523/FUL; 18/00872/FUL	Demolition, reconfiguration and extension of part of an existing class A1 retail building to create two new class A1 retail units and associated works	440 m
Barn Farm Cottage Stanboro Lane Elmstone Hardwicke Cheltenham Gloucestershire GL51 9TN	16/00885/FUL	Construction of 1x detached dwelling on land adjacent to Barn Farm Cottage, including associated parking, landscaping and a 4m acoustic fence along the southern and eastern boundaries.	Adjacent
Sheldon Nurseries Stanboro Lane Elmstone Hardwicke Cheltenham Gloucestershire GL51 9TN	18/00717/OUT; 17/01358/OUT	Outline consent for the siting of a single storey timber chalet to provide accommodation for a rural worker. With access and layout for approval.	Adjacent
10 Oakfield Withybridge Gardens Boddington Cheltenham Gloucestershire GL51 9TL	19/00536/CLP	Siting of a mobile home for use as a granny annex.	50 m
Pigeon House Farm The Green Uckington Cheltenham Gloucestershire GL52 9QB	18/01218/OUT	Outline application for the removal of an agricultural building and the erection of 4 dwellings with all matters reserved except for access.	130 m

Location	Reference	Description	Distance to Scheme Centreline
The Old Dairy The Green Uckington Cheltenham Gloucestershire GL51 9SR	18/00379/FUL	Proposed detached garage/store and extended parking/turning area.	115 m
Land Adjacent To 32 Homecroft Drive Uckington Cheltenham Gloucestershire GL51 9SN	16/01196/FUL	Erection of pair of semi-detached houses with off street parking	Adjacent
Civil Service Sports Association Tewkesbury Road Uckington Cheltenham Gloucestershire GL51 9SL	19/00656/FUL	Replace existing wooden tennis clubhouse (4.6m x 2.4m) with flat roof container (7.3m x 2.7m)	Adjacent
Barn Close Old Gloucester Road Boddington Cheltenham Gloucestershire GL51 0SW	16/00141/FUL	Demolition of 2 no. existing glasshouses and erection of 1 no. dwelling	110 m
Warners Of Cheltenham Blaisdon Way Cheltenham Gloucestershire GL51 0WH	15/00578/OUT	Outline application for the redevelopment of land at the junction of Blaisdon Way and Pilgrove Way for residential use with indicative layout of 10 dwellings and including removal of car wash facility (approval sought for means of access with other matters reserved)	270 m
Elms Park Tewkesbury Road Cheltenham Gloucestershire	20/00759/FUL	Demolition of a dwelling and the erection of 260 dwellings (Use Class C3), new vehicular and pedestrian access off Manor Road, attenuation basin and ancillary infrastructure	250 m
Gallagher Retail Park Tewkesbury Road Cheltenham Gloucestershire	17/01459/FUL	Erection of a Class A1 retail unit comprising 929 sqm at ground floor with full cover mezzanine, car parking, re-alignment of service yard access, renewal / adjustment of service yard drainage, diversion of a Class 5 highway, and associated works to the west of Unit A Gallagher Retail Park. | Gallagher Retail Park Tewkesbury Road Cheltenham Gloucestershire	Adjacent

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Appendices

Appendix A - Surface water abstractions and discharges

Table A-1 - Surface water abstractions

Scheme ID	Lic No.	Type	Receiving receptor	Distance (km) from M5 J10[136]
35	18/54/20/0410	Construction: General Use (High Loss)	River Chelt	2.6 south east
36	18/54/20/0410	Construction: General Use (High Loss)	River Chelt	3.0 south east

Data source: Landmark. July 2019. Envirocheck ® Report

Table A-2 - Surface water discharges

Scheme ID	Lic No.	Type	Receiving receptor	Distance (km) from M5 J10[137]
1	CS/20/25062/R/2	Sewage Discharges - Final/Treated Effluent - Water Company	River Chelt	0.8 south west
2	S/20/26207/R	Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company	River Chelt	0.8 south west
3	S/20/26207/R	Discharge Of Other Matter-Crude Effluent	River Chelt	0.8 south west
4	S/20/26207/R	Discharge Of Other Matter-Crude Effluent	River Chelt	0.8 south west
5	S/20/26207/R	Sewage Discharges - Final/Treated Effluent - Water Company	River Chelt	0.8 south west
6	S/20/25430/R	Discharge Of Other Matter-Crude Effluent	River Chelt	0.8 south west
7	S/20/25430/R	Sewage Discharges - Final/Treated Effluent - Water Company	River Chelt	0.8 south west
9	CS/20/25062/R/1	Sewage Discharges - Final/Treated Effluent - Not Water Company	River Chelt	0.8 south west
13	S/20/26016/S	Sewage Discharges - Final/Treated Effluent - Not Water Company	River Chelt	0.7 south east
14	S/20/26016/S	Sewage Discharges - Final/Treated Effluent - Not Water Company	River Chelt	0.7 south east
15	S/20/26540/S	Sewage Discharges - Final/Treated Effluent - Water Company	River Chelt	0.7 south east

[136] The distance point of reference is from the M5 J10 focal point, therefore the distances reported are slightly beyond 1 km, though are within 1 km of the options
[137] The distance point of reference is from the M5 J10 focal point, therefore the distances reported are slightly beyond 1 km, though are within 1 km of the options

Scheme ID	Lic No.	Type	Receiving receptor	Distance (km) from M5 J10[137]
16	S/20/26207/R	Sewage Discharges - Final/Treated Effluent - Not Water Company	River Chelt	2.4 south east
22	Ds/1070	Sewage Discharges - Final/Treated Effluent - Not Water Company	River Cam	1.6 south east
23	Ds/1002	Trade Discharge - Process Water	River Chelt	1.6 south east
25	Ds/1000	Sewage Discharges - Final/Treated Effluent - Not Water Company	River Chelt	1.6 south east
26	Ds/1001	PUMPING STATION ON SEWERAGE NETWORK (WATER COMPANY)	River Chelt	1.6 south east
28	S/20/25182/O	PUMPING STATION ON SEWERAGE NETWORK (WATER COMPANY)	Hesters Way Brook	1.9 south east
30	S/20/21419/O	Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company	Hesters Way Brook	2.4 south east
31	S/20/26207/R	Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company	River Chelt	2.2 south east
33	S/20/25430/R	Sewage Discharges - Final/Treated Effluent - Not Water Company	River Chelt	2.2 south east
43	S/20/26692/S	Sewage Treatment Works - Final Effluent	Unnamed Trib Of Leigh Brook	0.1 north west
45	CS/20/07430/S1	Sewage Discharges - Final/Treated Effluent - Not Water Company	River Chelt	0.9 south west
46	S/20/07430/S	Sewage And Trade Combined - Unspecified	River Chelt	0.9 south west
48	S/20/25278/T	Sewage Treatment Works - Final Effluent	Piffs Elm Brook	0.7 north west
50	S/20/05743/S/1	Sewage Discharges - Final/Treated Effluent - Water Company	Piffs Elm Brook	0.7 north west
53	S/20/05778/R/1	Sewage Discharges - Final/Treated Effluent - Water Company	Leigh Brook_R.Chelt	1.6 north west
54	S/17/26029/R	Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company	Hyde Brook	2.3 north east
56	S/17/26029/R	Sewage Discharges - Final/Treated Effluent - Water Company	Hyde Brook	2.3 north east

Data source: Landmark. July 2019. Envirocheck ® Report

Appendix B - Gazetteer of Heritage Assets

B.1. Designated Heritage Assets

Reference number	Name	Description	Period	Designation
1016835	Moat House Moated site	Moat House moated site survives well, despite the presence of later buildings on part of the island. Buried deposits on the island are likely to include the remains of medieval structures and will contain archaeological information relating to the construction and subsequent occupation and use of the moated site. Within the moat waterlogged deposits will have preserved archaeological remains relating to the occupation and use of the site, along with organic material which will provide information about the economy of the site and the local environment during the medieval period.	Medieval	Scheduled Monument
1172312	Church of St Mary Magdalen	Parish church constructed in the 12th-14th centuries, with C17 and C18 alterations. Restored late C19[138].	Medieval	Grade I
1091878	Chapel of St James the Great	Chapel-of-ease formerly attached to Bishops Cleeve. Nave probably built c1170. Chancel C14	Medieval	Grade I
1304748	Church of St Catherine	Parish church. C13, C14, possibly C15, 1712, 1735 (both datestones), vestry 1865, restored 1870-1884 by H.M. Townsend, 1897 by Prothero.	Medieval to post-medieval	Grade II*
1091887	Church of St Lawrence	Anglican parish church. C12, largely rebuilt in neo-Norman style, c1845 by T. Fulljames.	Medieval to post-medieval	Grade II*
1340067	Church of St Mary Magdalene	C15 Perpendicular, C19 porch and vestry, nave and south aisle, restored 1871-8 by John Middleton. Nave refaced C19 in coursed squared and dressed limestone.	Post-medieval	Grade II*
1088669	Staverton Lea Farmhouse	Former vicarage, now house. 1819-1824, said to incorporate part of an earlier house, mid-late C20 verandah.	Post-medieval	Grade II

[138] Following conventions in the NHLE, 'C' is used to denote century, so C14 is 14th century, C19 is 19th century, etc

Reference number	Name	Description	Period	Designation
1088670	Smith Monument, in the Churchyard, about 6 Metres South of the Tower, Church of St Catherine	Wife of W. Smith, died 1769.	Post-medieval	Grade II
1088671	Two St Clair Monuments in the Churchyard, about 2 Metres North East of North East Corner of Chancel, Church of St Catherine	Two pyramid pedestal tombs. D L St Clair, died 1861, his wife died 1851, by R Allen of Cheltenham. An unusual pair of monuments, set side by side at an angle to the church.	Post-medieval	Grade II
1152471	Pearce Monument, in the Churchyard, about 3 Metres South East of South East Corner of Chancel, Church of St Catherine	Short chest tomb. T. Pearce, late C18. Stone.	Post-medieval	Grade II
1251482	Pearce Monument in the Churchyard, about 1 1/2 Metres East of South East Corner of Chancel, Church of St Catherine	Pedestal tomb. W. Pearce, died 1784. Stone.	Post-medieval	Grade II
1341660	Old Manor House	Old Manor House (formerly listed as Manor Cottages). C15 or C16, altered and enlarged early C17, altered mid C19, mid C20, for Mrs. McIlquham	Post-medieval	Grade II
1340052	Manor Farmhouse	Detached farmhouse. C17 with C19 extensions	Post-medieval	Grade II
1154528	Bridge and attached pair of lodges Moat House	Bridge over moat and attached pair of lodges. Inscription on bridge 'CAST AT COALBROOKDALE 1851'. Lodges probably of the same date.	Post-medieval	Grade II
1153220	Hardwicke House and attached outbuildings	Detached farmhouse. Late C16-mid C17 and late C18-early C19.	Post-medieval	Grade II
1340058	The Gloucester Old Spot	Marked as the old White Swan on the 6 inch O.S. map. Inn. C18 and Cl9. Formerly known as Piffs Elm (after the publican's surname Piff) later the White Swan Inn, known to be in existence on site in 1755	Post-medieval	Grade II

Reference number	Name	Description	Period	Designation
1088723	Boddington House	Flats, former farmhouse. 1840 for John Arkell (datestone), altered late C20. Forms group with church.	Post-medieval	Grade II
1088724	Unidentified Monument in Churchyard about 1 Metre East of Porch, Church of St Mary Magadalene	Chest tomb. Mid C18. Stone	Post-medieval	Grade II
1172299	Boddington Manor	Former manor house, now offices. Probably C17, largely rebuilt early-mid C19, altered late C19, 1901.	Post-medieval	Grade II
1341650	Dovecote, Boddington Manor	Former dovecote. C17 or C18, later alterations. Interior not inspected: nests were still intact on the upper floor in 1979.	Post-medieval	Grade II
1088722	Cottages by drive to Butler's Court	Semi-detached cottages. C17, altered mid C20.	Post-medieval	Grade II
1340059	The Old Meeting House	Detached cottage. Late C16-mid C17.	Post-medieval	Grade II
1153885	Folly Cottage	Detached cottage. C17.	Post-medieval	Grade II
1091875	Stableblock and open fronted cart store, circa 10 metres north of Uckington Farmhouse	Stableblock dated and initialled 'A.L. 1818' on a diamond-shaped limestone plaque in the gable end facing the farmhouse.	Post-medieval	Grade II
1172363	The Old Forge	Probably C16, altered and extended C19, mid-late C20.	Post-medieval	Grade II
1305182	Withybridge Mill and Adjoining Barn	C17 barn, early C19 mill. Mill added to barn, end of barn altered for cowhousing, possibly C19.	Post-medieval	Grade II
1341699	Lower Court Farmhouse	C16-C17 farmhouse with C19, C20 alterations. Forms group with barn	Post-medieval	Grade II
1091927	Barn c 35m southeast of Green Farm	C18 barn. Timber-framing, basically comprising timber uprights, with weather boarding.	Post-medieval	Grade II

Reference number	Name	Description	Period	Designation
1340071	Chasebeams	Detached cottage. C17-early C18.	Post-medieval	Grade II
1303770	Uckington Farmhouse	Farmhouse. C17 with C19 extensions	Post-medieval	Grade II
1091917	Dovecote c. 40m south of Mill Farmhouse	Dated 1741 on a rectangular limestone plaque over a segmental-headed window in the left-hand return. Brick on a limestone plinth. Stone slate roof.	Post-medieval	Grade II
1304789	Barn, Grange Farm	Barn, and former cartshed and granary. Mid to late C18, altered C20.	Post-medieval	Grade II
1088725	Barn, About 15m west of Hayden Farmhouse	Barn. C17. Three-bay barn. Roof thatched until c1970.	Post-medieval	Grade II
1303797	Moat Cottage	Detached cottage. C17. Thatched roof with early brick stacks. Two eyebrow dormers.	Post-medieval	Grade II
1152428	Barn, Lower Court Farm	Barn: attached livestock housing beyond. Early C17. Forms group with farmhouse	Post-medieval	Grade II
1091877	Old Rowley	C17 square-panelled timber framing with painted brick infill on a stone plinth with a painted brick extension. Concrete tile roof, two coursed squared and dressed limestone stacks with shafts restored in brick. Area between stacks partly domed suggesting the position of a bread oven.	Post-medieval	Grade II
1304110	Mill Farmhouse	C17 and late C18 / early C19 farmhouse with later extensions.	Post-medieval	Grade II
1091874	Moat House	Early C17 core extensively altered early C19, probably by John Buckle. C17 core stone built, C19 alterations in brick. The house lies on a moated site	Post-medieval	Grade II
1340070	Ivy Cottage	Detached cottage. C17 and late C18 / early C19.	Post-medieval	Grade II
1264110	Appletree Cottage	Small detached cottage. Probably late C17 or early C18 extended right by one bay beyond stack. C19 bread oven in centre room, back, without flue. A sole surviving traditional building in an area developed in the late C20.	Post-medieval	Grade II

Reference number	Name	Description	Period	Designation
1152269	Evington House	C17 origins. Altered in 1830's for Sir Arthur Brooke; late C20 additions to rear.	Post-medieval	Grade II
1245524	The White House	Villa. c1810. Stucco over brick with double-pitch slate roof.	Post-medieval	Grade II
1245523	Arle Court House	House. Incorporates part of the Elizabethan Arle Manor (aka Arle Court) (dismantled 1880). Present front probably C17 or early C18, with earlier, C16, origins to rear and later alterations including C19 fenestration.	Post-medieval	Grade II
1172272	Butler's Court Farmhouse	Early C18 with early C19 alterations. 1849 (datestone), altered late C19 and mid C20.	Post-medieval	Grade II
1172346	Hayden Farmhouse	Farmhouse. Early C17, altered C18, C19, 1914, minor alterations mid C20.	Post-medieval	Grade II
1340069	Barn c. 30m north-west of the Moat House	Barn. Late C17-mid C18. Square-panelled timber framing with painted and unpainted brick infill. North gable end partly weatherboarded. Corrugated iron roof. threshing floor. South end of barn rebuilt in same style C20 following a fire.	Post-medieval	Grade II
1091872	John Greaves Monument, in the Churchyard of The Church of St Mary Magdalene, Circa 4 Metres South of the South West Corner of the South Aisle	Chest tomb to John Greaves. Limestone. C17.	Post-medieval	Grade II
1091873	Group of 4 Headstones And 2 Pairs of Headstones, in the Churchyard Of The Church Of St Mary Magdalene, Immediately South East of the South East Corner of the South Aisle	Row of 4 headstones. Left-hand headstone. Early C18. Sandstone to Mary Cook, wife of William Cook. Unidentified headstone to the right. Early C18. Headstone to John Butt, died 1711 to the right. Unidentified headstone to the right of the latter. Late, C17-early C18. Pair of headstones cl.5m to the east. Left-hand headstone. Limestone. Large incised initials 'I.B.' with foliate carving at the top. Right-hand headstone to Elizabeth Butt, died 1670. Pair of headstones cl.5m to the east. Left-hand headstone segmental-headed with a partially legible inscription to Elizabeth ----------, died 1696.	Post-medieval	Grade II
1154479	Joseph Pearce Monument and a Pair of Headstones, in the Churchyard of the	Chest tomb to Joseph Pearce, died 1789 and other members of their family. Sandstone on a limestone plinth.	Post-medieval	Grade II

Reference number	Name	Description	Period	Designation
	Church of St Mary Magdalene			
1154505	Group of 10 Monuments in the Churchyard of the Church of St Mary Magdalene, up to 10 Metres South East of the Chancel	Group of 10 monuments comprising a row of 8 headstones, a single headstone (forming part of a row) and a chest tomb to members of the Buckle family.	Post-medieval	Grade II
1303785	Charles Yeend Monument, in the Churchyard of the Church of St Mary Magdalene, circa 9 Metres South of the South Aisle	Pedestal tomb to Charles Yeend and other members of the Yeend family. C19.	Post-medieval	Grade II
1340068	John Byron Monument in the Churchyard of the Church of St Mary Magdalene	Chest tomb to the Reverend John Byron M.A., died 1878 and two of his daughters, died 1851 and 1858.	Post-medieval	Grade II
1091888	Row of 6 Headstones in the Churchyard of the Church of St Lawrence, Beside the Church Path Circa 3 Metres North of the North Door	Row of six C17-early C18 headstones. Limestone.	Post-medieval	Grade II
1091889	Row of 3 Monuments in the Churchyard of the Church of St Lawrence, C2 1/2 Metres East of the East End of the Chapel	Row of three chest tombs. C17-early C18. Limestone	Post-medieval	Grade II
1091890	the Old Rectory	Semi-detached house (attached to St Lawrence q.v.). Early-mid C19.	Post-medieval	Grade II
1091891	Old Swindon House	Semi-detached house. Late C18, probably extended early C19. he present garden front could possibly have once been the entrance front prior to the redirection of the main road through Swindon village during C19.	Post-medieval	Grade II

Reference number	Name	Description	Period	Designation
1091893	Queen Anne Cottage	One of pair of houses. Probably late C18-early C19. Brick, with incised render at front.	Post-medieval	Grade II
1154096	Two Unidentified Monuments in the Churchyard of the Church of St Lawrence, Circa 3 Metres North of the North West Corner of the North Aisle Beside the Church Path	Unidentified chest tomb and an unidentified headstone c2m to the left.	Post-medieval	Grade II
1154110	Unidentified Monument in the Churchyard of the Church of St Lawrence, Circa 8 Metres North of the Chancel	Unidentified chest tomb. C18.	Post-medieval	Grade II
1154128	Church Cottage	Detached cottage. C18.	Post-medieval	Grade II
1154142	St Lawrence	Semi-detached house (attached to The Old Rectory q.v.). Early-mid C19.	Post-medieval	Grade II
1303968	Swindon Manor	Large detached house. C17, largely rebuilt C18, some further alteration/extension early C19.	Post-medieval	Grade II
1088691	Walton Hill Farmhouse and Attached Farm Buildings	Farmhouse and stables. C17, c1800, early-mid C19, minor alterations mid C20.	Post-medieval	Grade II
1152168	Dovecote and Cider House, Grange Farm	Dovecote and cider house. C17, altered C19; late C19 cider house.	Post-medieval	Grade II
1262755	Manor Farmhouse	Formerly known as Walton Farm. Farmhouse. Some remains of C16 framing, substantial rebuild and refenestration in mid to late C19. An important survival with the adjacent early barn	Post-medieval	Grade II
1341678	Barn and Stables, Manor Farm	Barn and former stables. C15, C18, altered C19.	Post-medieval	Grade II

B.2. Non-designated Heritage Assets

Reference number	Name	Description	Period
38085	Bronze Age features	An isolated series of pits of unknown function were excavated by Cotswold Archaeology during 2010 in excavations at Kingsmead School/All Saints Academy. The pits contained prehistoric pottery, probably of the Middle Bronze Age.	Bronze Age
48010	Iron Age field system, Cursey Lane Solar Farm, Elmstone-Hardwicke, Gloucestershire.	The Iron Age activity was confined to a strip approximately 100m in width along the south-western site boundary. Archaeological features which date to the Iron Age to 1st-century AD were suggestive of settlement activity and agricultural use of the site in this period	Iron Age
27597	Roman agricultural features	An archaeological evaluation was undertaken by Gloucestershire County Council Archaeology Service on 09-23/06/2005. 13 trenches were excavated. 47 features were identified, 39 were undated but probably Romano-British and 8 were dated to the Roman period by pottery. The pottery sample was small and contained Roman, medieval and post medieval sherds which may have been deposited during manuring rather than being broken in situ.	Romano-British
29641	Ditches, pits and post holes probably representing a Roman field system,	A total of twenty archaeological features comprising ditches, pits (or ditches terminals) and post-holes, were recorded during the evaluation. The medieval ridge and furrow has partially truncated the Romano-British features	Romano-British
35022	Roman period features	A series of Roman period features were excavated within the 2010 evaluation trenches of AC Archaeology at Kingsmead School, Cheltenham. Finds included Roman period domestic waste including animal bone and pottery. It is possible, but unproven, that the undated features may be of this period as well	Romano-British
44923	Roman settlement remains	The features were found to date to the 2nd century AD, with no suggestion of pre-Roman activity. The ditched enclosures identified contained pottery of largely 2nd to 4th century date, with other finds including fragments of pyramid al loom weight, a Dressel 20 amphora neck and handle, and three nested mid1st/2nd century bowls which appeared to have been intentionally deposited.	Romano-British
49475	Roman features.	Archaeological remains of varying significance were identified. Where geophysical anomalies had been highlighted there was a good correlation with features observed,	Romano-British

Reference number	Name	Description	Period
		particularly plough furrows. There was also an archaeological component to the site beyond that located through geophysical survey, namely a number of small gullies or small pit and posthole features of at least two phases of activity. Roman (probably early Roman) and post-medieval artefacts were recovered, although a number of the features actually appeared more characteristic of prehistoric activity. The majority of these appeared to be restricted to the south-east part of the site, in an area of lower-lying and boggy ground, and it may be that they are reflective of more ephemeral activity rather than direct settlement	
5437	Roman site	Romano-British site noted on an EA Price aerial photograph of 1976. A later field visit confirmed the site with finds of red, black-burnished and colour-coated wares. Nothing is visible on RAF aerial photographs. The is an extensive complex of cropmarks to the north of the A4019	Romano-British
38084	Early Medieval buildings and pits.	A post-built building of 11m by 6m was recorded as based on posts of varying sizes and included an internal division at the southern end. This building may also have possessed a porch based on further postholes located outside the centre of the long walls. To the southeast of this a sunken-floored building was recorded of 6m by 2.7m. Sherds of Early Medieval pottery were recovered from contexts associated with each building; in the sunken floored building being concentrated in the northern and eastern parts of the structure. A series of Early Medieval pits were also excavated in the surroundings of these building and were found to contain a range of animal remains and pottery.	early medieval
38086	Early Medieval enclosure and pits.	Within Area 2 - the central area excavated - the enclosure was recorded as ditched enclosure extending beyond the limits of the excavation as a pair of ditches and within a series of internal pits.	early medieval
38087	Pair of crouched burials of Early Medieval and Unknown period	The human remains present have been identified as a pair of adult individuals, probably both male and dead before 30, though both were noted as complete and had suffered weathering/taphonomic processes prior to burial. Charred material from the grave fill of burial 2066 has been radiocarbon dated at 640 to 680 cal AD (Beta-294168) indicating of these burials to be probably 7th century in date.	early medieval
38083	Series of three Unknown period palaeochannels.	A series of three palaeochannels were partially excavated by Cotswold Archaeology during 2010 in excavations at Kingsmead School/All Saints Academy. The fills of these features were cut into by a series of Early Medieval pits	Unknown to early medieval

Reference number	Name	Description	Period
5370	Anglo-Saxon and medieval settlement with a medieval moat at Manor Farm, Stoke Orchard.	Stoke Orchard first appears in a document dated 967 as "aet Stoce" & also in 1086 as "Stoches". The earthworks in fields I and II are thought to be part of a moated site with house platforms within, Scatter of Medieval pottery found at SO918281 during 1973 site visit. Medieval and/or post-medieval building platforms, boundary ditches and ridge and furrow are visible as earthworks on historic aerial photographs and mapped as part of The Severn Vale NMP project	Early medieval to medieval
44477	Medieval moated site at the former Coal Research Establishment, Stoke Orchard.	The earthwork remains of a probable medieval moat are visible on historic aerial photographs and mapped as part of The Severn Vale NMP project. Located in Stoke Orchard village in an orchard between Manor Farm and the current Coal Research establishment site. Archaeological excavation dated remains to the 13th-14th centuries. Site now almost completely destroyed	medieval
4449	Medieval and/or post-medieval building platforms, boundary ditches and trackways in Stoke Orchard village are visible as earthworks on historic aerial photographs, at Waterloo Farm, Stoke Orchard.	Area of earthworks visible on RAF aerial photographs and only partially visible on mosaic aerial photograph regular enclosures fit in with present land parcel pattern and no definite indication of house platforms.	medieval
4462	Earthworks SW of Manor Farm-Deerhurst Walton.	An area of shrunken medieval and/or post-medieval settlement earthworks are visible at Deerhurst Walton on aerial photographs and were mapped as part of the Severn Vale NMP project. The main earthworks are located east of Oxleys Farm and south of the main road through the village at SO 88664 28067. The earthworks are not clear but they are defined by linear ditches, which roughly form two irregular enclosures between the road to the north and ridge and furrow to the south. They are also located in a field marked as Old House Ground on a map from 1815, and suggest that this was the location of a farmhouse or cottage	medieval
5377	The remains of a moat at Fisher's Farm	The earthwork remains of a medieval or post-medieval ditched enclosure adjoining a former moated site is visible on historic aerial photographs and mapped as part of The Severn Vale NMP project. Aerial photographs taken in 2006 show that Fisher's Farm has been demolished due to the construction of the adjacent M5 motorway, with no	medieval

Reference number	Name	Description	Period
		structures or other features upstanding. The moat's adjoining ditched enclosure location is now occupied by the M5 carriageway and presumably has been destroyed	
7470	Bar Bridge	Name Bar Bridge used as early as 1240	medieval
6473	Butler's Court: Moated site	Butler's Court - originally Withy Bridge Manor, mentioned 1419, moated site. This moated site may indicate the earliest settlement in Uckington	Medieval
26837	Boundary ditches.	Boundary ditches recorded during trenching in 2004 as a result of extension to burial ground. No evidence for the use of the development area as a burial ground was identified.	Medieval to post-medieval
4335	Post-medieval building platform earthworks.	The earthwork remains of four medieval or post-medieval building platforms, with ditches and possible trackways, located between Colman's Farm and Villa Farm, are visible on historic aerial photographs and mapped as part of The Severn Vale NMP project.	Medieval to post-medieval
4336	Medieval and post medieval site at Boddington Manor, Boddington.	The site of an ancient monastery mentioned by Leland as "a fair manor place and park". Relics have been found in the moat of its occupation by Parliamentary forces in the Civil War, when it withstood a Royalist attack. The present house is 19th.century and little now remains of the moat	Medieval to post-medieval
4447	Mill Farm Earthworks	Possible post-medieval or medieval settlement remains, with a complex of ditches, are visible as earthworks mapped as part of The Severn Vale NMP project. Mill Farm, Stoke Orchard.	Medieval to post-medieval
4466	Earthworks-Elvington House, visible as earthworks and cropmarks, Coombe Hill.	An extensive area of medieval to post-medieval ridge and furrow and drainage is visible as earthworks and cropmarks on aerial photographs throughout the parish of Leigh and was mapped as part of the Severn Vale NMP project. This has further highlighted the ditched enclosure in the north western corner of a larger enclosed area of ridge and furrow.	Medieval to post-medieval
47986	Ditched enclosure, a series of ditched enclosures or possible small paddocks or enclosing building platforms. Hardwicke House, Hardwicke.	The remains of contiguous blocks of medieval and/or post-medieval ridge and furrow cultivation are visible as earthworks on historic aerial photographs in the parish of Elmstone Hardwicke and were mapped as part of The Severn Vale NMP project	Medieval to post-medieval

Reference number	Name	Description	Period
5411	Old Mill on the site of 'The Homestead', Hayden Road, Swindon. Probable site of the Priests Mill.	Early records indicate the presence of a mill in 1200AD. The mill was described as a grist mill in the 17th century but by February 1775 was described as a "Cloth Mill and Dye House. situate in Bedlam in the parish of Swindon". Bedlam is a common derivative of St Mary of Bethlehem Hospital and was probably used in this area because much of the land was leased from St Margaret's Hospital. The mill was also referred to as Bedlam Mill in the 1841 and 1851 census. The working life of the mill seems to have ended by the start of the 19th century and none of the maps after this date refer to the buildings as a mill. Nonetheless, the 1841 tithe map shows a mill leat to the west of the mill and a mill pond to the east. The mill pond was filled in by Walter Yeend, who bought the mill in 1891. The mill wheel was photographed still in situ in 1984 and its housing is still visible today	Medieval to post-medieval
6474	Withybridge Mill on site of Medieval Uckington Mill	This is probably the site of Uckington Mill recorded in the Domesday Book. Field name "Mill Meadow" at SO 917 246 from amended Tithe Map and Apportionment dated 1855	Medieval to post-medieval
6476	Slate Mill	Slate Mill on River Chelt, probably the mill recorded in c1326, ceased working in 1960. All machinery now removed	Medieval to post-medieval
6477	Manor Mill or Boddington Mill	Manor Mill at the roadside opposite the Manor House grounds. Boddington Mill recorded in 1620 as Lower Mill (Upper Mill has not been located) One might have been 1086 Domesday Book mill. Plain brick with half-timbered gabled end.	Medieval to post-medieval
6991	Stoke Orchard Corn Mill	Disused corn mill and system of leats. A brick-built Victorian mill with half timbered house as a dwelling dating to the 16th - 17th centuries. Once owned by Gilbert de Clare. The wheel was formerly in the basement of a two storey mill. All the machinery is now gone but there is a forge nearby. A post-medieval mill race, visible as an earthwork, is visible as an earthwork on historic and contemporary aerial photographs and mapped as part of The Severn Vale NMP project. In Stoke Orchard the Earl of Gloucester's manor had a water-mill from the 14th century onwards. This is part of an 18th century built mill which was still potentially functioning in 1919 when it came up for sale.	Medieval to post-medieval
35023	Post Medieval ditch	A ditch was partially excavated within the Trench 9 of a series of 2010 evaluation trenches opened by AC Archaeology at Kingsmead School, Cheltenham. The ditch was not fully excavated and only present within the long, but narrow, trench for a length of 2.1m and infilled with a silty clays interspersed with charcoal flecks and small pieces of	Post-medieval

Reference number	Name	Description	Period
		gravel. The ditch is the continuation of a geophysical anomaly which was considered to be the remains of a former field boundary of Post Medieval date	
41800	Turnpike road from Gloucester to Norton.	Turnpike road that connected Gloucester and Norton was the first half of the road from Gloucester to Tewkesbury. Administered by the Cheltenham and Tewkesbury Turnpike Trust along with the Gloucester to Cheltenham turnpike. Established 1756.	Post-medieval
41838	Route of the 1785 Cheltenham Turnpike.	Turnpike road connecting Cheltenham with Birdlip having gone through Leckhampton and connecting Piffs End (the turnpike road from Gloucester to Tewkesbury) and Dowdeswell Hill having gone through Cheltenham as the High Street. Part of the Cheltenham Turnpike Trust	Post-medieval
43890	House, C18.	Locally Listed Building. The building was a wing added to a former mill building that was later converted to a farmhouse but demolished as part of modern housing development. Modernised. One and half storeys, pitched roof with four identical dormers. Timber framed.	Post-medieval
4337	Civil War activity at Boddington Manor, Boddington.	Record of the Civil War activity at the same location as HER4336	Post-medieval
48026	Post-medieval parkland features are visible as earthworks on aerial photographs. Part of Boddington Manor, Boddington.	Probable post-medieval parkland features are visible as earthworks on aerial photographs east of Boddington Manor (Monument Number 115635) and were mapped as part of the Severn Vale NMP project.	Post-medieval
50365	The Old Post Office, Staverton	Site of a house dating to the 18th century. This building is shown on the 1803 Staverton Inclosure map and 1873 Ordnance Survey map. Its site is now occupied by a late 20th century house, possibly suggesting the demolition of the 18th century building prior to construction, although as it was shown on mapping until the 1970s it is possible that it was incorporated into the later structure	Post-medieval
48685	Route of the Tewkesbury turnpike including the great road	In 1721 the inhabitants of Tewkesbury decided to do something about their Great Road to London and attempted to get an Act of Parliament passed to create a turnpike from Tewkesbury to the top of Stanway Hill at Stumps Cross. Five years later in 1726, their efforts were successful	Post-medieval

Reference number	Name	Description	Period
	to London from Tewkesbury.		
5548	Coombe Hill Canal	Coombe Hill Canal, built 1792-5, closed 1876. The Combe Hill Canal was cut 1796/7 from Wainlode to Combe Hill to bring coal from the Midlands to Cheltenham. It was 2.5 miles long, had a double entrance cock, and was abandoned in 1876. It is still watered, and has a cluster of cottages at the Wharf end	Post-medieval
6475	Mill near Churchyard	Mill at Boddington House, built c1880. Mill built to serve Boddington House Farm. Built c1880 therefore perhaps last mill in Gloucestershire to be built. Iron wheel there but high chimney felled in 1950. House dated 1840, cowshed 1846, therefore mill about the same date	Post-medieval
6997	Turnpike Gate	The Bedlam Gate of the Cheltenham and Tewkesbury turnpike is near Bedlam Farm	Post-medieval
7068	Turnpike House	Turnpike house and garden	Post-medieval
6978	Horse Trough	Pink granite horse trough at road junction, personal observation by BG Rawes, 1982	Post-medieval
27052	Site of a World War Two heavy anti-aircraft battery (A12) composed of mounted four 3.7-inch static guns and GL Mark II radar, and was manned by the Home Guard, in 1942. Haydons Elm, Boddington.	Anti-aircraft battery A12 - Haydons Elm recorded as part of the Gloucester/Brockworth gun defended area	Modern
27105	The possible site of Second World War searchlight battery no. 349 CL06 B5 at Staverton	The possible site of Second World War searchlight battery no. 349 CL06 B5 at Staverton. It was manned by 37 Searchlight Regiment. The battery was operational by October 1941. Withybridge Lane, Staverton. The probable searchlight battery is visible as faint lighter toned parchmarks in grass and was mapped as part of the Severn Vale NMP project. The remains of the battery visible ae located southwest of Withy Bridge (SO 90291 24595) and comprises a circular feature about 20 metres in diameter and an adjacent rectangular feature. Though the features are slight they do correspond to expected remains of a searchlight battery	Modern

Reference number	Name	Description	Period
43297	Home Guard store or shelter to the north of Old Forge, Staverton.	Thought that the outbuilding against the road was used as a store, before the construction of the support buildings associated with (HER 27052) Heavy Anti-Aircraft Battery	Modern
47959	The site of a Second World War shadow factory visible on historic aerial photographs	The site of a Second World War shadow factory, known as Unit 39, located in Stoke Orchard village is visible on historic aerial photographs and was mapped as part of the Severn Vale NMP project. Unit 39 was part of the Gloucester Aircraft Company (GAC) based at Brockworth, Gloucester and was the assembly shed for Hawker Hurricanes and Hawker Typhoons from 1943 onwards. These aircraft were tested at another nearby GAC shadow factory known as Unit 40 and then test flown from adjacent RAF Stoke Orchard airfield. The factory site (centred on SO 91910 28396) was accessed by an entrance on Stoke Road and consisted of one large rectangular building and numerous smaller buildings. The main assembly building was about 100 metres long and 42 metres wide and its roof was painted in a camouflage scheme during wartime. In 1950 the site was later taken over and expanded by the National Coal Board as the Coal Research Establishment, but has been disused since 1994. The main building and four of the smaller site buildings are still upstanding on aerial photographs dated 2007	Modern
48032	A Second World War shadow factory is visible on aerial photographs	A Second World War shadow factory is visible on aerial photographs and was mapped as part of the Severn Vale NMP project. It was located in what is now Gallagher Retail Park, Kingsditch at SO 93035 24386. The main factory was visible with camouflage paint on its roof. The buildings were demolished by 1975	Modern
7716	Cropmark of a possible pipeline route, Elmstone Hardwicke.	The cropmark probably relates to an unknown pipeline spotted by the Severn Vale NMP project. Part of this route is visible on the 1940s aerial photographs and it may have been repaired/extended in the 60s (the linear cropmark shows clearly on the OS prints from 1965 and 1969) and possibly again very recently (from Street View). The linear feature is not a gas pipeline or part of the Gloucestershire Security of Supply Pipeline with which it appears to share part of its (southerly) route	Modern
35024	Uncertain period deposit.	A deposit covering an area of approximately 5m of grey-brown silty clay, containing charcoal and gravels, and thin in thickness was recorded in Trench 7 of the 2010 evaluation trenches opened by AC Archaeology at Kingsmead School, Cheltenham. The deposit is undated and was only partially excavated in the long, but narrow, trench and the edges of deposit were not reached. The nature and extent of the deposit is unknown	unknown

Reference number	Name	Description	Period
38088	Series of three Unknown period ditches	The ditches were recorded in the centre of Area 3 - the most easterly of all those excavated. These features are thought connected with the drainage of the area and are probably of more recent dates than the other (Prehistoric and Early Medieval) activities recorded across the site. A post-excavation summary of the excavation work carried out suggests that these ditches may have related to the drainage/water channel management of the River Chelt floodplain.	unknown
44927	Potential ditches including a pair of parallel examples from the 2009 geophysical survey of land northwest of Cheltenham.	Archaeological evaluations found no finds or features of archaeological significance within the potential ditches.	unknown
44928	Potential pits/burnt materials and a penannular ditch	Potential pits/burnt materials and a penannular ditch from the 2009 geophysical survey of land northwest of Cheltenham	unknown
44929	Undated cropmarks to the east of Chestnut farm, Uckington.	Undated cropmarks to the east of Chestnut farm, Uckington are visible on a photograph by the RCHM(E) of 1984 to the east of Chestnut Farm. The features appear to comprise several linear ditches. Although their origin is uncertain it is possible that the pattern is in fact caused by field drains. The features were also partially visible on a 2009 geophysical survey of land northwest of Cheltenham	unknown
44930	Small rectilinear enclosure partially encompassed by curvilinear ditches	Small rectilinear enclosure partially encompassed by curvilinear ditches seen on the 2009 geophysical survey of land northwest of Cheltenham.	unknown
4659	Earthworks Coombe Hill/Deerhurst Walton	Line of square/rectangular enclosures strung along W side of road between Walton Grange Farm and Walton Hill Farm. Visible on RAF APs enclosures back onto ridge and furrow which covers the remaining area of the field. No positive indication of settlement could be discerned within the enclosures, which are presumably contemporary with the ridge and furrow	unknown

Reference number	Name	Description	Period
48027	Linear and curvilinear cropmarks of uncertain date and function	A rapid examination of air photography suggests the presence of linear features and a possible enclosure of Unknown date, visible as cropmarks southwest of Sheldon Nurseries. Linear and curvilinear cropmarks of uncertain date and function are visible on aerial photographs taken in 1984 and mapped as part of The Severn Vale NMP project. These appear to form part of a field system with enclosures and trackways. East of Boddington Manor, M5 Junction 10.	Unknown
48029	Area of cropmarks of probable Later Prehistoric to Romano-British settlement and field system.	Linear and curvilinear cropmarks of unknown date are visible on aerial photographs taken in 1984 {Source Work, 14558} and mapped as part of The Severn Vale NMP project. Continued plough levelling of the field as a consequence of intensive arable cultivation means that earlier archaeological features, previously protected by the overlying ridge and furrow earthworks, have become visible on aerial photographs as cropmarks	Unknown
48030	Linear, sub-circular and amorphous cropmarks of uncertain date.	Located adjacent to Church Lane Farm in Elmstone Hardwicke village, the features are visible within a field that had previously contained post-medieval ridge and furrow cultivation earthworks, as recorded from historic aerial photographs. Continued plough levelling of the field as a consequence of intensive arable cultivation means that earlier archaeological features, previously protected by the overlying ridge and furrow earthworks, are beginning to become visible on aerial photographs as cropmarks. The linear ditches and the maculae may be the remains of boundary ditches, trackways and buildings from a former settlement, possibly prehistoric or Romano-British	Unknown
5542	Square Enclosure	The undated square cropmark described above was viewed on aerial photographs as part of the Severn Vale NMP project. The supposed cropmark is located at 89270 27720, but reappraisal of the feature suggests that it is not likely to be archaeological in nature.	unknown
7071	Circular Cropmark	Rough patches show up on AP as a circular cropmark	Unknown
7469	Ponds at Manor Farm	Three large ponds at Manor Farm may have been derived from a moat	Unknown
8637	Area of cropmarks of probable Later Prehistoric to Romano-British settlement and field system complexes,	A series of cropmarks indicating the presence of a Later Prehistoric or Romano-British enclosed settlement are observable in this area from 2006 Get Mapping aerial photography of the area possibly hinted at by 19th century field name. Further features were identified as part of The Severn Vale NMP project. Uckington, Cheltenham. Fieldnames "In Black Length" from 1839 tithe map	unknown

Reference number	Name	Description	Period
9610	Land division likely to represent the course of an ancient highway which bypassed the medieval town	The road runs from the Cross Hands on Tewkesbury road W of Cheltenham across the N side of the town towards Hewletts Farm. Apparently formed part of a drift way from Gloucester and the Severn to the Cotswolds and London. Old road fell into disuse, parts being incorporated into new roads linking Cheltenham with surrounding farms and villages	unknown

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