M5 Junction 10 Improvements Scheme

Environmental Statement (ES)

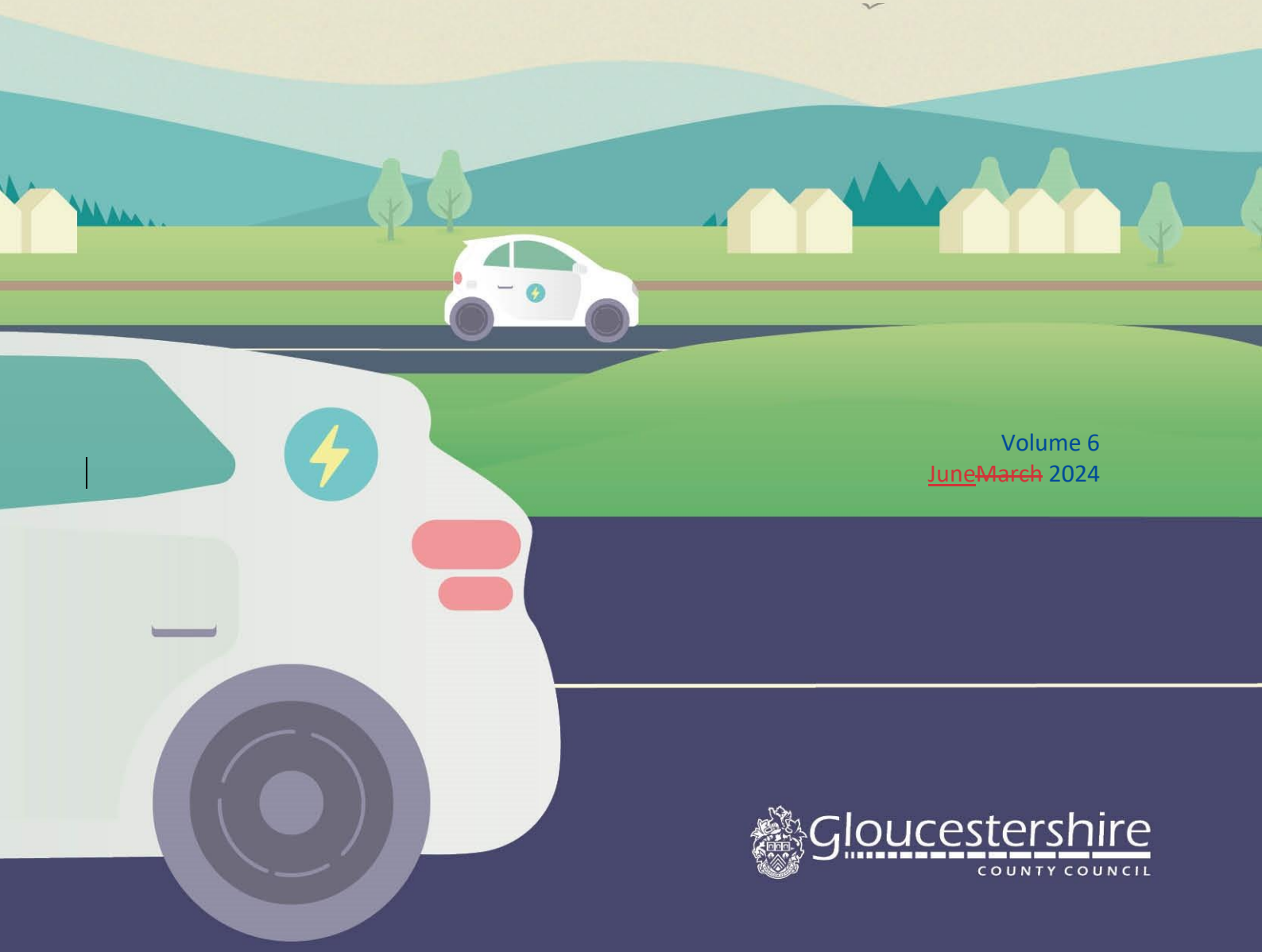
Chapter 7: Biodiversity

TR010063 – APP 6.5

Regulation 5(2)(a)

Planning Act 2008

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



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Infrastructure Planning

Planning Act 2008

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

M5 Junction 10 Improvements Scheme

Development Consent Order 202[x]

6.5 Environmental Statement (ES): Chapter 7: Biodiversity

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7. Biodiversity

7.1. Introduction

7.1.1. This chapter presents the environmental assessment of the M5 Junction 10 Improvements Scheme ("the Scheme") for Biodiversity, based on the Scheme as it is described in Chapter 2 – The Scheme (application document TR010063/—APP/-6.2) and detailed in the General Arrangement Plans (~~application~~Application document TR010063/—APP-/2.9).

7.1.2. The chapter summarises the regulatory and policy framework related to biodiversity, details the methodology followed for the assessment and describes the baseline terrestrial and aquatic biodiversity resources within and surrounding the Scheme. Following this, the design, mitigation and residual effects of the Scheme are discussed, along with the limitations of the assessment.

7.1.3. The assessment is based on the findings from desk study, terrestrial and aquatic ecological walkover surveys and a suite of detailed ecology surveys.

7.2. Competent expert evidence

7.2.1. The Biodiversity chapter has been produced by competent experts who are full members of the Chartered Institute of Ecology and Environmental Management (CIEEM) and Chartered Environmentalists, each with over fifteen years of professional consultancy experience. They have used their knowledge and professional judgement, as well as relevant standards and guidance, to undertake the assessment reported here.

7.3. Planning policy and legislative context

7.3.1. It should be noted that the details presented in this section are not intended to provide a full consideration of the relevant documents and their application to the Scheme. This information is provided within the Planning Statement and Schedule of Accordance with National Policy Statement (~~application~~Application document TR010063/—APP/-7.1) that accompanies the application for a Development Consent Order (DCO).

Legislative context

7.3.2. The following relevant legislation exists to protect habitats and species of nature conservation importance. These pieces of legislation include a number of offences relating to protected species which result in requirements for licences to allow construction works to proceed.

7.3.3. The legislation and policy relating to specific species are further detailed within the Technical Appendix reports (Appendices 7.1 to 7.18 [(~~application~~Application document TR010063—/-APP/-6.15]~~)~~).

The Conservation of Habitats and Species Regulations 2017 (as amended)[1] (the Habitats Regulations 2017)

7.3.4. The Habitats Regulations 2017 transpose the Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the Habitats Directive) and certain elements of the Wild Birds Directive (Council Directive 2009/147/EC) into UK law.

7.3.5. The Habitats Regulations 2017 cover the designation and protection of a network of important high-quality conservation sites (European Sites[2]) that will make a significant

[1]As amended by The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019.
[2] As defined in Regulation 8 of the Habitats Regulations 2017, these include: Sites of Community Importance (SCIs), Special Protection Areas (SPAs), potential SPAs (pSPAs), Special Areas of Conservation (SACs), candidate SACs (cSACs) and

contribution to conserving the habitats and species identified in Annexes I and II, respectively, of the Habitats Directive. The Habitats Regulations 2017 also cover the protection of European protected species (in Part 3, Regulations 42 to 49).

7.3.6. Regulation 8 of the Habitats Regulations 2017 defines SPAs as European Sites. SPAs are designated based on populations of Annex 1 species that they support, and thus comprise the most suitable habitats to ensure the survival and/or reproduction of these species in their area of distribution.

7.3.7. Of particular relevance to the determination of this DCO application are Regulations 9 and 10. Regulation 9 places a duty on public authorities to have regard to the requirements of the Birds Directive in the exercise of their functions.

7.3.8. Regulation 10 places a duty on public authorities to take steps in the exercise of their functions to contribute to the achievement of the preservation, maintenance and re-establishment of a sufficient diversity and area of habitat for wild birds in the United Kingdom.

The Convention on Wetlands of International Importance Especially as Waterfowl Habitat (1971) (Ramsar Convention)

7.3.9. The Ramsar Convention is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

7.3.10. Ramsar sites are wetlands of international importance that have been designated under the criteria of the Ramsar Convention for containing representative, rare or unique wetland types or for their importance in conserving biological diversity.

Wildlife and Countryside Act 1981 (as amended)

7.3.11. This is the primary legislation which protects animals, plants and habitats in the UK.

7.3.12. It covers: the protection of birds, animals and plants; measures to prevent the establishment of non-native species which may be detrimental to native wildlife; and the designation of protected areas (Sites of Special Scientific Interest (SSSIs) and National Nature Reserves (NNRs)).

Natural Environment and Rural Communities (NERC) Act 2006 (as amended)

7.3.13. The NERC Act 2006 (as amended) places a duty on public authorities to have regard to conservation and enhancement of biodiversity while exercising their functions, as well as placing a duty on the Secretary of State to produce a list of organisms of principle importance for conservation of biodiversity in England (referred to as priority habitats and species and collectively as the 'England Biodiversity List').

The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017

7.3.14. The Water Environment Regulations (WER) (2017) is the leading legislation relating to the duties of regulators (Environment Agency in England) in relation to environmental permitting, abstraction, and impoundment of water. Its principal aims are to protect and improve the water environment and promote the sustainable use of water, as follows:

- To prevent deterioration of the status of water bodies.
- To protect, enhance and restore all water bodies with the aim of achieving 'good status' by 2027 at the latest.

possible SACs (pSACs). Ramsar sites, proposed Ramsar sites and sites compensating for damage to a European Site are also considered to be European Sites in accordance with UK Government policy (Ministry of Housing, Communities and Local Government (DecemberJuly 20231) National Planning Policy Framework). Following the changes made to the Conservation of Habitats and Species Regulations 2017 (as amended) by the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019, SACs and SPAs in the UK no longer form part of the EU's Natura 2000 ecological network and now form part of a UK national site network. In this document they are still referred to as European Sites.

- To progressively reduce or phase out the release of individual pollutants or groups of pollutants and cease or phase out emissions, discharges and losses of priority hazardous substances.
- To prevent or limit the entry of pollutants to groundwater.
- To comply with the requirements of all Water Framework Directive (WFD) Protected Areas.

The Environment Act 2021

7.3.15. The Environment Act 2021 became law in November 2021. The legislation builds on the 25 Year Environment Plan (see below), and includes the provision of targets, plans and policies for improving the natural environment; including environmental protection, waste and resource efficiencies; air quality; water, nature and biodiversity.

7.3.16. Part 6 of the Act makes provision for biodiversity net gain (BNG), which will, once in force, apply to applications under the Town and Country Planning Act 1990 and Nationally Significant Infrastructure Projects. The Act requires developments to deliver a minimum of 10% BNG. It requires that habitat is secured for at least 30 years via planning conditions or conservation covenants, and appropriate management and monitoring through the production of a Habitat Management and Monitoring Plan (HMMP). Habitat can be delivered on-site, off-site or via statutory biodiversity credits.

7.3.17. It is anticipated that BNG will become mandatory at the end of 2023 for applications under the Town and Country Planning Act 1990, and in November 2025 for Nationally Significant Infrastructure Projects. The Scheme has an objective of establishing BNG.

7.3.18. In addition, the responsibilities on Government or public bodies have changed, including through strengthening the existing biodiversity duty, requiring biodiversity reports; setting up local nature recovery strategy areas, providing for national habitat mapping; and establishing species conservation and protected sites strategies.

Salmon and Freshwater Fisheries Act 1975

7.3.19. The Act makes it illegal to poison or injure fish, their spawn, spawning grounds and the food of such fish.

The Eels (England and Wales) Regulations 2009

7.3.20. The Regulations give powers to the regulators (the Environment Agency and Natural Resources Wales) to implement recovery measures of European eel stocks in all freshwater and estuarine waters in England and Wales.

The Protection of Badgers Act 1992

7.3.21. 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.

7.3.22. 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

7.3.23. The wildlife and landscape criteria for determining ‘important’ hedgerows is set out in Schedule 1, Part 2 of The Hedgerow Regulations 1997. This has been used as part of the assessment of the hedgerow resource. In general, ‘important’ hedgerows are at least 20 metres in length, over 30 years old and contain certain species of plant.

7.3.24. Under the regulations, it is against the law to remove or destroy certain ‘important’ hedgerows without permission from the local planning authority. The local planning authority will assess the importance of the hedgerow using criteria set out in the regulations. In addition, the local planning authority must be notified of all hedgerow removals. For this Scheme, permission is deemed as part of the development consent.

The Invasive Alien Species (Enforcement and Permitting) Order 2019

7.3.25. The Enforcement Order requires management measures to be put in place for 14 widespread invasive alien species. These management measures seek to minimise the effect these species have on biodiversity, related ecosystem services, human health and the economy.

National policy and guidance

National Policy Statement for National Networks (NPS NN, 2014)[3,4]

7.3.26. The NPS NN sets out the need for, and Government's policies to deliver, development of NSIPs on the national road and rail networks in England. It provides planning guidance and is the basis for the examination by the Examining Authority and decisions by the Secretary of State.

7.3.27. Paragraphs 5.20 – 5.38 of NPS NN, 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.'

7.3.28. 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.

7.3.29. 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 2017.

7.3.30. Paragraph 5.28 discusses 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.'

7.3.31. 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.

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

7.3.33. Paragraph 4.23 sets out that any application should be accompanied by sufficient information to enable the examining authority to undertake an appropriate assessment under the Habitats Regulations 2017.

[3] Department for Transport (December 2014) National Policy Statement for National Networks.
[4] A ministerial statement on 22 July 2021 by Grant Shapps (the then Secretary of State for Transport) ~~indicates~~ indicated that the NPS NN will be reviewed, with a proposed completion date of no later than Spring 2023. A revised draft NPS NN was published for public consultation in March 2023. The consultation ~~closes~~ closed in June 2023. The current expectation is that the draft NPS NN will take effect before the end of 2023 and will be relevant to applications accepted for examination after the new NPS NN is adopted. For applications accepted before the new NPS NN is adopted, the current NPS NN will continue to have effect. On this basis the assessment for this Scheme is against the policies of the current NPS NN.

National Planning Policy Framework (NPPF, 2023)[5]

7.3.34. The NPPF does not form the basis for decision making on NSIPs, and in the event of conflict with the NPS NN, the NPS NN takes precedence. However, the NPPF is likely to be an important and relevant matter that the Secretary of State will consider in their determination of the application.

7.3.35. Paragraph 180~~74~~ states that 'planning policies and decisions should contribute to and enhance the natural and local environment by:

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

7.3.36. Paragraph 185 ~~79~~ builds on this by stating that plans should protect and enhance biodiversity through the identification, mapping 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; wildlife corridors and stepping stones that connect them; and areas identified by national and local partnerships for habitat management, enhancement restoration and creation'. 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.'

7.3.37. Paragraph 186~~80~~ 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.'

The UK Biodiversity Action Plan (BAP) and Post-2010 Biodiversity Framework 2012[6]

7.3.38. 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 2012.

Biodiversity 2020: A Strategy for England's Wildlife and Ecosystem Services (DEFRA, 2011)[7]

7.3.39. Biodiversity 2020 is a national strategy for England's wildlife and ecosystem services. It sets out the Government's ambition to halt overall loss of England's biodiversity by 2020, support healthy well-functioning ecosystems and establish coherent ecological networks, with more and better places for nature for the benefit of wildlife and people.

A Green Future: Our 25 Year Plan to Improve the Environment (DEFRA, 2018)[8]

7.3.40. The Plan sets out government action for improving the environment, within a generation. It aims to deliver cleaner air and water in our cities and rural landscapes, protect threatened species and provide richer wildlife habitats. It calls for an approach to agriculture, forestry, land use and fishing that puts the environment first.

[5] Ministry of Housing, Communities and Local Government (~~July~~ December 2023~~2021~~) National Planning Policy Framework.
[6] JNCC and DEFRA (on behalf of the Four Countries' Biodiversity Group). 2012. UK Post-2010 Biodiversity Framework. July 2012. Available from: http://jncc.defra.gov.uk/page-6189.
[7] Department for Environment, Food & Rural Affairs (DEFRA) (2011) Biodiversity 2020: A strategy for England's wildlife and ecosystem services.
[8] HM Government (2018) A Green Future: Our 25 Year Plan to Improve the Environment.

Our Plan to Protect and Increase Biodiversity (Highways England, 2015)[9]

7.3.41. The Scheme includes improvement works to the strategic road network controlled by National Highways.

7.3.42. National Highways (formerly Highways England) must minimise environmental impacts and protect and enhance the quality of the surrounding environment (as per the terms of National Highway's licence from the Department for Transport). National Highways also has a key performance indicator, which states that improved biodiversity must be delivered, as set out in the organisation's Biodiversity Action Plan. The Operational Metrics Manual[10] sets out the parameters for measuring and monitoring performance against the key performance indicators.

7.3.43. Specifically, National Highways is expected to maximise biodiversity delivery through: landscape scale biodiversity projects that reduce habitat fragmentation; new projects which enhance biodiversity value of land and therefore reduce their impacts; an increased number of SSSI which are in favourable or recovering condition; managed woodland areas that are meeting their intended purpose; grassland areas that are managed appropriately; and 3,500 hectares of grassland rich in wildflower species.

7.3.44. The plan sets out the approach to meet the above expectations and address biodiversity challenges, and contains five specific outcomes, with a series of related actions. The five outcomes are as follows:

- 'Outcome 1: Highways England and our suppliers are equipped to produce good biodiversity performance.
- Outcome 2: The Strategic Road Network is managed to support biodiversity.
- Outcome 3: We have delivered biodiversity enhancements whilst implementing a capital programme of network improvement.
- Outcome 4: We have addressed the legacy of biodiversity problems on our network via a targeted programme of investment.
- Outcome 5: We are fully transparent about our biodiversity performance.'

Regional/local policy and guidance

Gloucestershire's Local Transport Plan (LTP) 2020–2041[11]

7.3.45. The LTP sets out the strategic transport vision for the county to 2041.

7.3.46. LTP PD 0.2 – Local Environmental Protection states that 'Gloucestershire County Council (GCC) will work with District Councils and other partners; to minimise the impact of transport on landscapes, townscapes, heritage assets and the wider historic environment; to protect and enhance the water environment, air quality, soils and agricultural resources; to reduce the risk of flooding and the levels of noise pollution; to achieve BNG and conserve geodiversity and the historic environment, from traffic or improvements on the highway network. GCC will do this by implementing the following policy proposals:

- Protect and avoid harm to geodiversity and biodiversity associated with transport infrastructure in addition to taking opportunities to enhance the natural environment wherever practicable.
- Comply with Gloucestershire Highways Biodiversity Guidance or subsequent guidance and the Green Infrastructure Pledge.

[9] Highways England (June 2015) Our plan to protect and increase biodiversity. Available from: biodiversity-plan.pdf (highwaysengland.co.uk).
[10] Highways England (January 2019) Operational Metrics Manual.
[11] Gloucestershire County Council (2020) Gloucestershire's Local Transport Plan 2020 – 2041.

- Maximise the opportunities for transport interventions to contribute towards major new initiatives, including Nature Recovery Networks and large scale woodland creation and other similar measures that would help achieve BNG targets.
- Support Natural England's work on the Green Transport Corridors and Green Infrastructure Agreements, as well as their recommendations of the Linear Infrastructure Network, ensuring that within or adjacent to the rail network and Major Road Network, green infrastructure can deliver biodiversity gains, ecological connectivity and ecosystem services.' [only bullet points relevant to biodiversity have been included in this quotation].

7.3.47. Policy LTP PD 4.1 – Gloucestershire's Highway Network states that 'GCC will maintain a functioning highway network that supports Gloucestershire's transport network by ensuring the safe, accessible and expeditious movement of highway users.' GCC will do this by implementing the following policy proposals:

- Follow green infrastructure principles in the design, maintenance and operation of highway asset as set out in the green infrastructure pledge as well as meeting Building with Nature standards. [only bullet points relevant to biodiversity have been included in this quotation].

7.3.48. Policy 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 winter maintenance and vegetation clearance procedures and policies, in line with the Gloucestershire Highways Biodiversity Guidance (or subsequent guidance).

7.3.49. Policy LTP PD 4.3 – Highway Maintenance states that 'GCC will manage the local highway asset management in line with the Highways Asset Management Framework and other guidance or policies such as the Code of Practice for Well Managed Highway Infrastructure. GCC will do this by implementing the following policy proposals:

- Complying with the Gloucestershire Highways Biodiversity Guidance or subsequent guidance. Enhance and restore the wildlife function of highway verges by continuing to work in partnership with Gloucestershire Wildlife Trust (GWT) through GCC's Conservation Road Verges Site Register to ensure that all road verges receive appropriate conservation management as part of highways maintenance and related schemes.' [only bullet points relevant to biodiversity have been included in this quotation].

Joint Core Strategy (JCS) 2011-2031[12]

7.3.50. The JCS is a partnership between Gloucester City Council, Cheltenham Borough Council (CBC) and Tewkesbury Borough Council (TBC) which sets out a strategic planning framework for the three areas.

7.3.51. 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 Cotswolds National Landscape (formerly known as the Cotswolds AONB~~ National Landscape)~~ ~~'s AONB,~~ and areas of landscape and biodiversity importance.'

7.3.52. 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.

7.3.53. 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,

[12] Gloucester City, Cheltenham Borough and Tewkesbury Borough (Adopted December 2017) Joint Core Strategy 2011 – 2031.

appropriate mitigation should be provided through 'integrating enhancements into the Scheme that are appropriate to the location.'

7.3.54. The Strategy states that it provides an opportunity to deliver some of the objectives and complement the work programme of the Gloucestershire Local Nature Partnership (GLNP). It refers to the Gloucestershire Nature Map, which sets out spatial priorities for ecological conservation and enhancement across the county. A key part of this is the identification of a number of Strategic Nature Areas (SNAs), which are the key landscape-scale blocks of land where characteristic habitats that typify the county can be expanded and linked to support wildlife. SD9 encourages habitat creation and restoration within these SNAs and associated Nature Improvement Areas (NIAs).

Cheltenham Plan Adopted July 2020[13]

7.3.55. The Cheltenham Plan refers to the JCS policy SD9 with regard to biodiversity. In addition, it includes two policies relating to the Cotswold Beechwoods SAC, as outlined below.

7.3.56. Policy BG1: Cotswold Beechwoods SAC Recreation Pressure states that development will not be permitted where it would be likely to lead directly or indirectly to an adverse effect upon the integrity of the European Site network (alone or in combination) and the effects cannot be mitigated. In order to retain the integrity of the Cotswold Beechwoods SAC, all development within the borough that leads to a net increase in dwellings will be required to mitigate any adverse effects.

7.3.57. Policy BG2: Cotswold Beechwoods SAC Air Quality states that 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.

Tewkesbury Borough Plan 2011 – 2031[14]

7.3.58. The Tewkesbury Borough Plan refers to the JCS as providing the overarching policies in respect of biodiversity, but adds a number of non-strategic, local level policies, as outlined below.

7.3.59. Policy NAT1 Biodiversity, Geodiversity and Important Natural Features states that 'development proposals that will conserve, restore and enhance, biodiversity will be permitted.' It goes on to make the following points:

- 'Proposals will, where applicable, be required to deliver a BNG across local and landscape scales, including designing wildlife into development proposals, the connection of sites and large-scale habitat restoration, enhancement and habitat re-creation. Locally defined ecological networks identified in the Local Nature Recovery Strategy will be the primary focus for landscape scale net gain delivery.'
- 'Proposals that are likely to have a significant effect on a European or internationally designated habitats site (either alone or in combination with other plans or projects) will not be permitted unless a Habitats Regulations Assessment has concluded that the proposals will not adversely affect the integrity of the habitats site.'
- 'Development likely to result in the loss, deterioration or harm to features, habitats or species of importance to biodiversity, environmental quality or geological conservation, either directly or indirectly, will not be permitted unless: (a) the need for, and benefits of the development clearly outweigh its likely impact on the local environment, or the nature conservation value or scientific interest of the site; (b) it can be demonstrated that the development could not responsibly be located on an alternative site with less harmful impacts; and (c) measures can be provided (and secured through planning conditions or legal agreement) that would avoid, mitigate against or, as a last resort, compensate for the adverse effects likely to result from development.'

[13] Cheltenham Borough Council (Adopted July 2020) Cheltenham Plan.
[14] Tewkesbury Borough Council (Adopted June 2022) Tewkesbury Borough Plan 2011 – 2031.

- 'The level of protection and mitigation should be proportionate to the status of the feature, habitat or species and its importance individually and as part of a wider network. Development resulting in the loss or deterioration of irreplaceable habitat, including (but not restricted to) ancient woodland and ancient and veteran trees, will not be permitted unless there are wholly exceptional reasons and a suitable compensation strategy exists.'

Cotswolds Area of Outstanding Natural Beauty (AONB) Management Plan 2018 – 2023 (Cotswold Conservation Board, 2018)[15]

7.3.60. The Scheme lies approximately 4.5 km west of the Cotswolds ~~AONB~~National Landscape. Policy CE7: Biodiversity states that biodiversity in the Cotswolds ~~AONB~~National Landscape should be conserved and enhanced by establishing a coherent and resilient ecological network across the Cotswolds ~~AONB~~ National Landscape and in its setting, focussing on the priority species and habitats listed in Appendix 8. This should be achieved by protecting existing wildlife sites, increasing the size of existing wildlife sites, creating more wildlife sites and improving connectivity between wildlife sites.

Gloucestershire Highways and Biodiversity Guidance (2022)[16]

7.3.61. The guidance recommends early consideration of biodiversity impacts, as this reduces the risk of future delays, and also allows opportunities for wildlife to be developed. It identifies the value of highway habitats, which can sometimes support remnants of ancient features, for example old meadows and species-rich hedgerows, provide refuges for some species, links to wider ecological networks within the landscape, and provide buffers if situated adjacent to designated sites of nature conservation value.

7.3.62. It identifies the main biodiversity impacts of highways including: habitat loss and fragmentation, the presence of a physical barrier, pollution, hydrological and soil changes, changes in the numbers of predators and/or prey, disturbance, introduction of non-native invasive species and inappropriate management.

7.3.63. The guidance identifies that good design, landscaping, green bridges and wildlife underpasses can mitigate some of these impacts and, as a last resort, offsite compensatory measures. Practical management advice for a variety of newly created and existing habitats is given, as well as suggested mitigation and enhancement measures for biodiversity. These recommendations in particular have been taken into consideration during the development of mitigation for this Scheme.

Gloucestershire Local Nature Partnership (GLNP)

7.3.64. The GLNP came into being in response to the Government's 2011 Natural Environment White Paper[17]. GCC is a key member of the partnership, along with GWT. The GLNP incorporated the Gloucestershire Biodiversity Action Plan (BAP)[18] and adopted the Gloucestershire 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.

7.3.65. In line with the launch of the Government's 25 Year Environment Plan, the GLNP, led by GWT, is in the process of transforming the Gloucestershire Nature Map into the Gloucestershire Nature Recovery Network[19]. This will take the form of a spatial GIS-based master plan for nature restoration covering the entire county, which will complement the natural capital mapping being undertaken by the GLNP and build upon the Gloucestershire Nature Map (which identifies SNAs).

[15] Cotswolds Conservation Board (2018) Cotswolds Area of Outstanding Natural Beauty Management Plan 2018 – 2023.
[16] Gloucestershire County Council (May 2022, version 3.2) Gloucestershire Highways and Biodiversity Guidance.
[17] HM Government (2011) The Natural Choice: Securing the Value of Nature.
[18] Gloucestershire Biodiversity Partnership (2000) Gloucestershire Biodiversity Action Plan. The Gloucestershire BAP was launched on 5 April 2000. It contains a series of Habitat Action Plans and Species Action Plans. 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.
[19] Further information at www.gloucestershirenature.org.uk

7.3.66. The GLNP works within its Growing Natural Success 2021 – 2024 strategy. Over this period, the GLNP is committed to building on its achievements since 2012. Five areas have been identified as key strategic themes, including:

- Nature's recovery.
- Climate resilience.
- Green growth.
- Naturally healthy.
- People at the heart of nature.

Gloucestershire Tree Strategy (Gloucestershire Local Nature Partnership, 2020)[20]

7.3.67. The vision of the strategy is a thriving network of sustainably managed trees and woodlands covering at least 20% of the county by 2030, delivering resilience and connectivity for people, wildlife and the economy.

7.4. Methodology

Assessment methodology

7.4.1. The assessment has followed guidance from CIEEM[21], LA 104 Environmental Assessment and Monitoring[22] (hereafter referred to as LA 104), LA 108 Biodiversity[23] (hereafter referred to as LA 108) and LD 118 Biodiversity Design[24] (hereafter referred to as LD 118). The significance of effects on biodiversity resources identified has been categorised, where appropriate, according to LA 108 and considers both on-site impacts and those that may occur to adjacent and more distant biodiversity resources.

7.4.2. The assessment process has also relied on professional judgement by individuals with relevant expertise, and decisions have been made in consultation with stakeholders including Natural England.

Valuation of resources

7.4.3. Biodiversity resources have been valued broadly following the geographical framework provided in Table 3.9 of LA 108, as detailed in Table 7-1 (below). In some instances, the evaluation has deviated from Table 7-1, and this is fully justified within the relevant Technical Appendix reports (Appendices 7.1 to 7.18 [A(application document TR010063/APP/6.15)]). The evaluation is based on the information gathered from the desk study and field surveys, using a combination of professional judgement and accepted criteria[25] (e.g. diversity, rarity and naturalness).

[20] Gloucestershire Local Nature Partnership (September 2020) Gloucestershire Tree Strategy.
[21] 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.
[22] Highways England (2020). Design Manual for Roads and Bridges. LA 104 Environmental assessment and monitoring (formerly HA 205/08, HD 48/08, IAN 125/15, and IAN 133/10). (March 2020, version 1). Online: [redacted].
[23] Highways England (2020). Design Manual for Roads and Bridges. LA 108 Biodiversity (formerly Volume 11, Section 3, [redacted].
[24] Highways England (2020). Design Manual for Roads and Bridges. LD 118 Biodiversity Design (formerly LA 118 which superseded HA 59/92, HA 67/93, HA 80/99, HA 81/99, HA 84/01, HA 97/01, HA 98/01, HA 116/05, UAN 116/08, IAN 116/08(W)) (March 2020, version 0) Online: [redacted].
[25] Set out in Ratcliffe, D.A. (1977). A Nature Conservation Review. Cambridge University Press.

Table 7-1 - Biodiversity resource importance (Ttaken from LA 108, Table 3.9)

Biodiversity Rresource Iimportance	
International or European importance	
Sites	Sites including: 1. European Sites: a) Sites of Community Importance (SCIs); b) Special Protection Areas (SPAs); c) Potential SPAs (pSPAs); d) Special Areas of Conservation (SACs); e) Candidate or possible SACs (cSACs or pSACs); f) Wetlands of International Importance (Ramsar sites). 2. Biogenetic Reserves, World Heritage Sites (where recognised specifically for their biodiversity value) and Biosphere Reserves. 3. Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such.
Habitats	N/A
Species	Resident, or regularly occurring, populations of species which can be considered at an international or European level where: 1. The loss of these populations would adversely affect the conservation status or distribution of the species at an international or European scale; or 2. The population forms a critical part of a wider population at this scale; or 3. The species is at a critical phase of its life cycle at an international or European scale.
UK or national importance	
Sites	Sites including: 1. Sites of Special Scientific Interest (SSSIs) or Areas of Special Scientific Interest (ASSIs); 2. National Nature Reserves (NNRs); 3. National Parks; 4. Marine Protected Areas (MPAs) including Marine Conservation Zones (MCZs); or 5. Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such.
Habitats	Habitats including: 1. Areas of UK BAP priority habitats; 2. Habitats included in the relevant statutory list of priority species and habitats; and 3. Areas of irreplaceable habitats including: a) Ancient woodland; b) Ancient or veteran trees; c) Blanket bog; d) Limestone pavement; e) Sand dunes;

Biodiversity Rresource limportance	
	f) Salt marsh; g) Lowland fen; 4. Areas of habitat which meet the definition for habitats above, but which are not themselves designated or listed as such.
Species	Resident, or regularly occurring, populations of species which can be considered at an international, European, UK or national level where: 1. The loss of these populations would adversely affect the conservation status or distribution of the species at a UK or national scale; or 2. The population forms a critical part of a wider population at this scale; or 3. The species is at a critical phase of its life cycle at a UK or national scale.
Regional importance	
Sites	Designated sites (non-statutory) including heritage coasts.
Habitats	Areas of habitats identified (including for restoration) in regional plans or strategies (where applicable).
Species	Species including: 1. Resident, or regularly occurring, populations of species which can be considered at international, European, UK or national level where: a) The loss of these populations would adversely affect the conservation status or distribution of the species at a regional scale; or b) The population forms a critical part of a wider regional population; or c) The species is at a critical phase of its life cycle. 2. Species identified in regional plans or strategies.
County or equivalent authority importance	
Sites	Wildlife/nature conservation sites designated at a county (or equivalent) level including: 1. Local Wildlife Sites (LWS); 2. Local Nature Conservation Sites (LNCS); 3. Local Nature Reserves (LNRs); 4. Sites of Importance for Nature Conservation (SINCs); 5. Sites of Nature Conservation Importance (SNCIs); 6. County Wildlife Sites (CWSs).
Habitats	Areas of habitats identified in county or equivalent authority plans or strategies (where applicable).
Species	Species including: 1. Resident, or regularly occurring, populations of species which can be considered at an international, European, UK or national level where: a) The loss of these populations would adversely affect the conservation status or distribution of the species at a county or unitary authority scale; or

Biodiversity Rresource limportance	
	b) The population forms a critical part of a wider county or equivalent authority area population, e.g. metapopulations; or c) The species is at a critical phase of its life cycle. 2. Species identified in a county or equivalent authority area plans or strategies.
Local importance	
Sites	Wildlife/nature conservation sites designated at a local level including: 1. Local Wildlife Sites (LWS); 2. Local Nature Conservation Sites (LNCS); 3. Local Nature Reserves (LNRs); 4. Sites of Importance for Nature Conservation (SINCs); 5. Sites of Nature Conservation Importance (SNCIs); 6. Sites of Local Nature Conservation Importance (SLNCIs).
Habitats	Areas of habitat considered to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange.
Species	Populations/communities or species considered to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal or genetic exchange.

NOTE 1 Geological Sites of Special Scientific Interest are assessed and reported within LA 109.
NOTE 2 Where a biodiversity resource falls into more than one category, the highest value category applies.
NOTE 3 Where biodiversity resources are not designated but meet the published selection criteria or where there is uncertainty over importance of biodiversity resources, this can be agreed in consultation with the relevant environmental body.
NOTE 4 Critical phases of a species life-cycle can include seasonal activity or behaviour upon which survival or reproduction depends.

7.4.4. The valuation of bat roosts, commuting and foraging habitat has been informed by guidance on valuing bats in ecological impact assessment by Wray *et al*[26]. The guidance provides a framework for assigning roosts, commuting and foraging habitat to geographic importance categories that are consistent with the values defined in LA 108.

7.4.5. Biodiversity resources that have been identified to be of less than local importance are important at the site level only and have been scoped out of the EIA as they cannot trigger significant effects. Where mitigation is required for these resources for legal reasons, this is detailed in Section 7.8.

Characterisation of impacts

7.4.6. The level of impact has been determined by 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.

7.4.7. The level of impacts on biodiversity resources are reported in accordance with the criteria provided in Table 3.11 of LA 108, as detailed in (Table 7-2 below), and in accordance with

[26] Wray et al., Valuing Bats in Ecological Impact Assessment (provided within CIEEM (2010) In Practice Number 70)

CIEEM guidelines, taking into consideration any embedded mitigation measures[27], and again taking into consideration any additional essential mitigation measures.

Table 7-2 - Level of impact and typical descriptions (taken from LA 108, Table 3.11)

Level of ~~l~~impact (C~~c~~hange)		Typical D~~d~~escription
Major	Adverse	• Permanent/irreversible damage to a biodiversity resource; and • The extent, magnitude, frequency, and/or timing of an impact negatively affects the integrity or key characteristics of the resource.
	Beneficial	• Permanent addition of, improvement to, or restoration of a biodiversity resource; and • The extent, magnitude, frequency, and/or timing of an impact positively affects the integrity or key characteristics of the resource.
Moderate	Adverse	• Temporary/reversible damage to a biodiversity resource; and • The extent, magnitude, frequency, and/or timing of an impact negatively affects the integrity or key characteristics of the resource.
	Beneficial	• Temporary addition of, improvement to, or restoration of a biodiversity resource; and • The extent, magnitude, frequency, and/or timing of an impact positively affects the integrity or key characteristics of the resource.
Minor	Adverse	• Permanent/irreversible damage to a biodiversity resource; and • The extent, magnitude, frequency, and/or timing of an impact does not affect the integrity or key characteristics of the resource.
	Beneficial	• Permanent addition of, improvement to, or restoration of a biodiversity resource; and • The extent, magnitude, frequency, and/or timing of an impact does not affect the integrity or key characteristics of the resource.
Negligible	Adverse	• Temporary/reversible damage to a biodiversity resource; and • The extent, magnitude, frequency, and/or timing of an impact does not affect the integrity or key characteristics of the resource.
	Beneficial	• Temporary addition of, improvement to, or restoration of a biodiversity resource; and • The extent, magnitude, frequency, and/or timing of an impact does not affect the integrity or key characteristics of the resource.
No change		• No observable impact, either positive of negative

[27] Design measures (mitigation, compensation and enhancement measures) which are integrated into a project for the purpose of minimising environmental effects. Relevant embedded mitigation measures are described in paragraphs 7.8.1 to 7.8.35~~7.8.32~~.

Assessment of significance of effects

7.4.8. The importance of the resource and level of impact has been used to determine the significance of effect using the matrix in Table 3.13 of LA 108, shown in Table 7-3 (below).

Table 7-3 - Significance matrix (Taken from LA 108, Table 3.13)

	Level of impact					
		No change	**Negligible**	**Minor**	**Moderate**	**Major**
Resource importance	**International or European importance**	Neutral	Slight	Moderate or large	Large or very large	Very large
	UK or national importance	Neutral	Slight	Slight or moderate	Moderate or large	Large or very large
	Regional importance	Neutral	Neutral or slight	Slight	Moderate	Moderate or large
	County or equivalent authority importance	Neutral	Neutral or slight	Neutral or slight	Slight	Slight or moderate
	Local importance	Neutral	Neutral	Neutral or slight	Neutral or slight	Slight

7.4.9. Significant effects typically comprise effects that remain within the moderate, large or very large significance categories once mitigation has been taken into account (i.e. residual effects), as explained in Table 7-4~~Table 7-4~~ below.

Table 7-4 - Significance categories and typical descriptions (taken from LA104[28])

Value	Typical D~~d~~escriptors
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.

Establishing the study area

7.4.10. The study area extends beyond the Scheme Boundary in accordance with LA 104[28] and CIEEM guidelines[21], and to accommodate minor design changes.

7.4.11. Unless otherwise stated, the term 'Scheme Boundary' refers to the DCO Order limits, excluding areas of the Order limits that extend approximately 2 km north and 2 km south of the Scheme alignment, along the M5. In these locations where the Order limits extends north and south of the Scheme alignment along the M5, the Scheme Boundary is the Scheme alignment. The Order limits and the Scheme alignment are shown on the figures in the General Arrangement Plans (application document TR010063/~~-~~-APP/~~P~~ 2.9).

7.4.12. Within the areas of the Order limits that extend north and south along the M5, the only works proposed are the installation of signs in discrete locations, which will require

[28] Highways England (2020). Design Manual for Roads and Bridges. LA 104 Environmental assessment and monitoring (formerly HA 205/08, HD 48/08, IAN 125/15, and IAN 133/10). (March 2020, version 1). Online:

vegetation clearance of up to approximately 20 m^2 plus some minor trimming back of vegetation up to a distance of 180 m in front of the sign to ensure visibility. These signage locations can be micro sited to avoid/minimise ecological impacts. These small-scale works are consistent with routine highway maintenance works. The results of desk study and field surveys here would not have any bearing on the impact assessment for the Scheme, and these areas have been excluded from assessments to inform the ES. Pre-construction surveys of the discrete signage locations and working with the contractor to micro site locations where appropriate to avoid or minimise ecological impacts will be undertaken, and is considered to be proportionate.

7.4.13. The Affected Road Network (ARN) refers to the parts of the road network that would be affected by a change in traffic levels as the result of the Scheme. LA 105[29] states that designated habitats (European Sites, statutory and non-statutory designated nature conservation sites, nature improvement areas, areas of ancient woodland and veteran trees) within 200 m of the ARN should be included in the air quality assessment (which is detailed in the Chapter 5 – Air Quality [A(application document TR010063/APP/6.3]). This is linked to potential air quality impacts to habitats as a result of NOx emissions and nitrogen deposition from road traffic. The desk study areas described below, incorporate this search area. The habitat survey area described below is also aligned with this distance for consistency (even though such designated habitats are not present within 200 m of the Scheme Boundary), as it is considered to be the likely maximum distance over which there would be impacts to terrestrial habitats as a result of the Scheme.

7.4.14. The distance that the study area extends beyond the Scheme Boundary for each receptor was determined by the likely spatial scale of potential significant effects for each type of biodiversity resource, i.e. the Ecological Zone of Influence (EZoI). These are based on good practice guidance, where available (references provided), but in most cases are determined by professional judgement. The various initial study areas are listed below and are shown on Figure 7A. They are further refined in Table 7-9 (in Section 7.7, below).

- 30 km from the Scheme Boundary for identification of European Sites where bats are one of the qualifying features[30].
- 2 km from the Scheme Boundary for identification of all other statutory designated nature conservation sites, including European Sites, SSSIs, National Nature Reserves (NNRs) and Local Nature Reserves (LNRs). This is extended to any distance where there is a direct hydrological connection, or any other form of ecological connectivity that could result in indirect impacts.
- 2 km from the Scheme Boundary for identification of any bat species records.
- 1.5 km from the Scheme Boundary for identification of any barn owl records and up to 1.5 km from the Scheme for assessment of habitat for its potential to support barn owl, followed by further, targeted surveys as necessary.
- 1 km from the Scheme Boundary for identification of non-statutory designated nature conservation sites (e.g. Local Wildlife Sites), records of priority habitats[31] and ancient woodland and ancient and veteran trees.
- 1 km from the Scheme Boundary for identification of any other protected or priority[32] species records.

[29] Highways England (2019). Design Manual for Roads and Bridges. LA 105 Air Quality (formerly HA 207/07, IAN 170/12, IAN 174/13, IAN 175/13, part of IAN 185/15). (November 2019, version 0) Online: 10191621-07df-44a3-892e-c1d5c7a28d90 [redacted].

[30] Highways England (2020). Design Manual for Roads and Bridges. LA 115 Habitats Regulations Assessment (formerly HD 44/09). (January 2020, version 1) Online: h[redacted]df

[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] Priority 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.

- 500 m from the Scheme Boundary 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 Boundary for assessment of habitat for its potential to support protected or priority species.
- 200 m from the Scheme Boundary for habitat surveys.
- 200 m from the ARN for identification of European Sites, Statutory and non-statutory designated nature conservation sites, nature improvement areas, areas of ancient woodland and veteran trees for the assessment of air quality impacts as a result of nitrogen deposition from road traffic emissions[29].
- 150 m from the Scheme Boundary for identification of aquatic features (watercourses and standing waterbodies), hereafter referred to as the aquatic feature screening area. For watercourses identified within the aquatic feature screening area, the study area is extended up to 2 km upstream and downstream from the Scheme Boundary for hydrologically connected aquatic features, designated sites, and background records.
- 50 m from the Scheme Boundary for badger surveys.
- 40 m from the Scheme Boundary for assessment of buildings and trees for bat roost potential, extended to include all buildings and trees between the Link Road and the M5, which would potentially be isolated by the Scheme.

Baseline data collection

7.4.15. Further information on species and habitat specific surveys are detailed within the Technical Appendix reports (Appendices 7.1 to 7.18 [(Aapplication document TR010063 –/APP/-6.15]); a summary is provided here.

Desk study

7.4.16. A desk-based data gathering exercise was undertaken in September 2019, April 2021 and July 2022 to collect existing information on biodiversity resources within the study areas described above. Details of the searches and data sources are provided below.

7.4.17. In 2018, ECUS undertook a Preliminary Ecological Appraisal (PEA) for the Scheme[34]. This was reviewed to obtain relevant information, although the Scheme has changed in scope since the original survey.

7.4.18. The MAGIC website[35] was reviewed to identify:

- European Sites within 30 km of the Scheme Boundary where bats are one of the qualifying features.
- Statutory designated nature conservation sites within 2 km of the Scheme Boundary or those with a direct hydrological connection to the Scheme up to any distance.
- Priority habitats and ancient woodland within 1 km of the Scheme Boundary.
- Granted European Protected Species (EPS) licences[36] within 1 km of the Scheme Boundary (2 km for bats).
- European Sites, Statutory designated nature conservation sites and areas of ancient woodland within 200 m of the ARN.

[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).
[34] ECUS (2019). M5 J10 Preliminary Ecological Appraisal. Report prepared for Amey OW PLC, December 2018.
[35] https://magic.defra.gov.uk/MagicMap.aspx [Accessed August 2022]
[36] Licences granted by Natural England to permit activities that might otherwise cause a breach of the Conservation of Habitats and Species Regulations 2017, with respect to species protected by that legislation.

7.4.19. The Woodland Trust's Ancient Tree Inventory website[37] was reviewed to locate records of ancient and veteran trees within 1 km of the Scheme Boundary and within 200 m of the ARN. The arboricultural survey (which is appended to Chapter 9, the Landscape chapter, in Technical Appendix 9.4 [(Aapplication document TR010063—/-APP/-6.15])) was also reviewed to identify ancient and veteran trees within the Scheme Boundary.

7.4.20. Historic and recent aerial imagery was reviewed using Google Earth Pro (version 7.3.3) to supplement and refine the boundaries between habitats that were noted in the field.

7.4.21. Gloucestershire Centre for Environmental Records (GCER) was contacted on 11 September 2019, and again on 12 April 2021 and 14 July 2022 to obtain recent records[38] of the following:

- Non-statutory designated nature conservation sites within 1 km of the Scheme Boundary and within 200 m of the ARN.
- Bat species records within 2 km of the Scheme Boundary.
- Barn owl records within 1.5 km of the Scheme Boundary.
- Other protected and priority species within 1 km of the Scheme Boundary.

7.4.22. Ordnance Survey (OS) maps and satellite imagery were reviewed to identify the following:

- Waterbodies that could be suitable for great crested newt within 500 m of the Scheme Boundary.
- Buildings that could support bat roosts within 40 m of the Scheme Boundary, or that would be isolated by the Scheme (i.e. where existing connections to surrounding habitat would be severed by new roads).

7.4.23. Documents associated with the North West Cheltenham Development Area (Elms Park) planning application (reference 16/02000/OUT) located north of the A4019, east of Uckington, were obtained from the Tewkesbury Borough Council website[39]. Details regarding the West Cheltenham Development Area located to the south of the Link Road and the safeguarded land to the north-west of Cheltenham between Uckington and the M5 were obtained through consultation with the relevant landowners/developers. These areas are shown on Figure 2-3 in Chapter 2 – The Scheme (Aapplication document TR010063/—APP/-6.2).

7.4.24. A desk study was undertaken to identify watercourses and standing waterbodies (ponds[40] and lakes[41]) potentially affected by the Scheme. The aquatic feature screening area was set at 150 m from the Order limits[42]. The following data sources were used to identify aquatic features:

- OS Mapping and aerial imagery[43].
- OS Open Rivers[44].
- Esri World Topographic Map[45].
- Environment Agency Main Rivers Map[46].

7.4.25. Background aquatic habitat and species records from within the last five years have been reviewed. For aquatic features identified within the screening area, the search for background records has been undertaken within 2 km upstream and downstream of the

[37] [redacted] August 2022]
[38] Records of observations within the last 10 years.
[39] https://publicaccess.tewkesbury.gov.uk/online-applications
[40] Man-made or natural standing water bodies less than 2 ha (20,000 m^2) in area.
[41] Man-made or natural standing water bodies greater than 2 ha (20,000 m^2) in area.
[42] The stretches of the M5 corridor extending approximately 2 km north and 2 km south of the highway alignment are included with respect to the aquatic feature screening area.
[43] Available from: Free OS OpenData Map Downloads | Free Vector & Raster Map Data | OS Data Hub
[44] [redacted]

Order limits to identify the presence of hydrologically connected aquatic features, designated sites and ecological background records. 2 km defines the ecological zone of influence (measured in linear watercourse extent) from the Order limits. The search for background records for fish has been extended to 10 km within the last 10 years, an approach that has been agreed in consultation with the Environment Agency and Natural England.

7.4.26. The following data sources have been used to obtain species (aquatic macroinvertebrates, aquatic macrophytes and fish) and habitat records:

- MAGIC website[47].
- Environment Agency Severn River Basin Management Plan[48].
- Environment Agency Fish and Ecology data explorer for aquatic macrophytes, aquatic invertebrates and fish[49].
- Environment Agency Data Catchment Explorer[50].
- Environment Agency River Habitat Survey monitoring data from the Government data website[51].
- Other project data that includes Habitat Suitability Index (HSI) surveys which are detailed in in Technical Appendix 7.11 – Great Crested Newt Survey (~~application~~Application document TR010063~~—~~/~~-~~APP~~-~~/6.15).

Field surveys

7.4.27. The following section outlines the ecological survey work that has been undertaken to inform the ES. Surveys for terrestrial ecology were led by suitably experienced ecologists considered competent to undertake specific surveys in accordance with CIEEM[52]. Aquatic habitats and species surveys (excluding protected species) are not directly covered by the CIEEM competencies for species surveys. Aquatic surveys were led by suitably experienced specialist aquatic ecologists following standard Environment Agency sampling methods for aquatic macroinvertebrates, aquatic macrophytes and fish. River Habitat Surveys (RHS) were led by Environment Agency accredited surveyors and MoRPh surveys were undertaken by an accredited MoRPh surveyor. The methodologies for the surveys are described in detail within the corresponding Technical Appendix reports (Appendices 7.1 to 7.18 [~~(~~Aa~~a~~pplication document TR010063~~—~~/~~-~~APP/~~-~~6.15]~~)~~).

Extended Phase 1 habitat survey

7.4.28. Habitat classification was undertaken in accordance with the Joint Nature Conservation Committee (JNCC) Phase 1 Habitat Survey methodology[53]. Habitats were recorded on base maps of the study area. Target notes were used to describe the characteristic plant species and any habitats/features suitable for protected and priority species or signs of their presence.

7.4.29. An extended Phase 1 habitat survey of accessible land within 250 m of the Scheme Boundary was undertaken in May and September 2019 to validate habitat mapping undertaken previously by ECUS and identify habitats and features that could potentially support protected and priority species within the study area.

7.4.30. An extended Phase 1 habitat survey of the M5 motorway verges within the Scheme Boundary was undertaken in September and October 2021.

7.4.31. A Phase 1 habitat validation survey was undertaken in May and June 2022. Given that the survey data from 2019 is almost four years old (at DCO submission), the purpose of

[47] https://magic.defra.gov.uk/MagicMap.aspx [Accessed August 2021]
[48] https://www.gov.uk/government/publications/severn-river-basin-district-river-basin-management-plan
[49] https://environment.data.gov.uk/ecology/explorer/
[50] https://environment.data.gov.uk/catchment-planning/
[51] https://data.gov.uk/data/search [Accessed August 2021]
[52] https://cieem.net/resource/competencies-for-species-survey-css/
[53] 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

the validation surveys was to update the Phase 1 habitat data as necessary and provide an indication as to whether any of the baseline conditions had changed significantly in the interim period and validate, or otherwise, the results described and conclusions drawn in relation to a number of ecological receptors. These surveys covered land within the Scheme Boundary only, as it was considered appropriate to focus the survey effort on the habitats that would be directly affected, within the temporary and permanent land take areas for the Scheme. Further detail is included in paragraphs 7.4.727.4.73 - 7.4.747.4.75 and Technical Appendix 7.17 - Validation Report (Aapplication document TR010063—/APP/-6.15).

7.4.32. As discussed in paragraph 7.4.137.4.14, the study area for habitat surveys was subsequently reduced to 200 m and the habitat results presented in Section 7.6 only include information on habitats within this revised area.

7.4.33. Further detail about the Phase 1 surveys is included in Technical Appendix 7.1 – Phase 1 Habitat Survey (Aapplication document TR010063—/-APP/-6.15).

Hedgerow

7.4.34. The extended Phase 1 habitat survey undertaken in May and September 2019 included the recording of species-rich/species-poor hedgerows, intact/defunct hedgerows, and hedgerows with/without trees. The Phase 1 habitat survey methodology does not specify the criteria for species-rich/species-poor hedgerows, and hedgerows with/without trees. Therefore, these definitions and the definitions of a hedgerow were taken from the Hedgerow Survey Handbook[54]:

7.4.35. Hedgerows identified as being potentially important, located either partially or entirely within the Scheme Boundary, were subject to a targeted hedgerow survey, where permitted and safe access allowed, to determine their wildlife and landscape importance in accordance with The Hedgerow Regulations 1997. This assessment only applies to those hedgerows within the Scheme Boundary that would be directly impacted by the Scheme. Targeted hedgerow surveys were undertaken between June and August 2019, in June 2021, and in May and June 2022. The survey methodology followed the guidelines provided in the Hedgerow Survey Handbook. These targeted surveys recorded information on the following: height and width, presence of gaps, presence of banks, walls and ditches, presence of trees, adjacent land use and proximity of other ecological features, species present, management, and evidence of use by animal species. 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[55] (refer to Chapter 11 – Cultural Heritage (Aapplication document TR010063—/-APP/-6.9) for an assessment against the archaeology and history criteria of the Hedgerow Regulations 1997). Further detail about the hedgerow surveys is included in Technical Appendix 7.2 – Hedgerow Survey (Aapplication document TR010063—/-APP/ 6.15).

Bats

7.4.36. Bat surveys were undertaken in accordance with the Bat Conservation Trust (BCT) good practice survey guidelines56. Surveys undertaken comprised:

- Preliminary Roost Assessment (PRA) of structures and Ground Level Tree Assessment (GLTA) of trees. These began in 2019 and continued into 2022 as access became available and as the Scheme design evolved. DNA analysis was undertaken for bat droppings found within trees or structures.

[54] DEFRA (2007) Hedgerow Survey Handbook. A standard procedure for local surveys in the UK. DEFRA, London.
[55] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/438652/hedgerow__guide_part_1.pdf. Accessed 16 September 2021.
[56] Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London.

- Emergence/re-entry surveys of buildings structures assessed as having greater than negligible bat roost potential during the PRA began in 2019 and continued into 2022.
- Hibernation surveys of structures were carried out where the structure was deemed to have high hibernation suitability (i.e. underground culverts, confirmed bat roosts (with the exception of those with negligible potential for hibernating bats) or where the loft could not be fully inspected but access was available). The hibernation surveys of structures comprised a full spectrum static bat recorder being left within the structure (or in the case of culverts, left outside the entrance, with the microphone pointing inside the culvert, with a wooden back shield to reduce picking up bat calls outside of the culvert). On each occasion the detector was left for a minimum of two weeks between December and February with a temperature and humidity data logger (taking hourly readings).
- Tree climbing inspections of trees 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 high potential were climbed three times in the survey season (May – September).
- 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. These were undertaken between July and September 2020.
- Hibernation surveys of trees were carried out where the tree was deemed to have high hibernation suitability or a confirmed bat roost. The hibernation survey of trees comprised one visit, between December and February 2020, where an aerial tree climb by a licensed bat surveyor using an endoscope was undertaken.
- The study area was assessed to be of moderate suitability for foraging and commuting bats. On this basis, bat activity surveys, comprising transect surveys and static detector surveys were undertaken to identify levels of activity, key foraging and commuting areas, and the bat species present. Nine transect routes were surveyed from June to October between 2019 and 2022. Two static detectors were located along each transect. Another 15 static detectors were deployed across the survey area to provide additional information on the surrounding habitat (for example, paired static detectors were placed under the M5 J10 bridge to determine if bats were crossing under the bridge). Static detector surveys were completed between June and October, between 2019 and 2022. A suite of activity update surveys were undertaken in 2021. These comprised eight transect routes surveyed once per survey season. This follows the methodology for low suitability habitat, as detailed in the Bat Survey Guidelines, as it was considered that reduced survey effort was appropriate for the update surveys. Twenty-four static bat detectors were also deployed.
- 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[57]. Six repeat surveys at each of the five locations were undertaken in 2020 and were repeated in 2021. The need for crossing point surveys at four additional locations along the A4019 were identified due to Scheme changes, and these were undertaken in 2021.
- Advanced Licence Bat Survey Techniques (ALBST) for bats, focusing on Bechstein's bat with the aim of establishing their use of the landscape affected by the Scheme, were undertaken in 2021.

[57] Berthinussen, A. & Altringham, J. (2016) *Development of A Cost Effective Method For Monitoring The Effectiveness Of Mitigation For Bats Crossing Linear Transport Infrastructure.* University of Leeds/DEFRA.

7.4.37. Further details about the bat surveys are included in Technical Appendix 7.3 – Bat Survey (Aapplication document TR010063—/-APP-/6.15).

7.4.38. Despite the extensive survey efforts, some gaps remain in the bat roost survey data and it has been necessary to predict the bat roosts present within unsurveyed/partially surveyed structures and trees, using existing survey data and taking a reasonably precautionary approach. Further information about the approach taken is detailed within Section 2.6 and Appendix F of Technical Appendix 7.3 – Bat Surveys (Aapplication document TR010063—/–APP/–6.15). The mitigation and compensation provided, and presented in this ES, have been designed to account for the known roosts, as well as the predicted bat roost resource present within unsurveyed/partially surveyed structures and trees. It is anticipated that pre-construction surveys will address the gaps in the bat roost survey data, and it will be necessary to refine the mitigation and compensation package proposed here, in consultation with Natural England. However, given the precautionary approach taken to establishing the predicted roost resource, it is considered that the package of mitigation and compensation provided is the maximum that would be required for the Scheme. The authors therefore have confidence that any impacts to bats can be effectively mitigated and compensated for within the Scheme design, and within the Order limits. The emerging 2023 survey work, which is not reported in this ES, is confirming that a precautionary approach has been taken, and the predicted roosts presented here are likely to be an over-estimation. This, combined with lower levels of impacts anticipated, will likely result in a reduction in the mitigation and compensation package required.

Dormouse

7.4.39. Hazel dormouse surveys have been undertaken in accordance with good practice guidance[58]. An initial dormouse habitat suitability assessment was undertaken in May and September 2019 during the extended Phase 1 habitat surveys, which covered the Scheme Boundary plus a 250 m buffer. The initial walkover survey included an assessment of habitat type, structure, species composition and connectivity with other areas of suitable habitat outside the survey area.

7.4.40. Dormouse nest tube surveys were carried out between May and November 2019. A total of 666 artificial nest tubes were placed in seven distinct areas in suitable habitat (woodland, hedgerows and scrub) and checked by a licensed surveyor every two months up to November 2019.

7.4.41. Due to changes in the Scheme extent, further dormouse nest tube surveys were undertaken between March and November 2021 along the A4019 corridor to the north and south of the road. A total of 220 nest tubes were deployed within hedgerows and scrub along the A4019 in March, which were checked every two months up to November 2021.

7.4.42. In order to update the 2019 survey data, dormouse surveys were undertaken in 2022 between May and September within the most suitable habitat within the 2019 dormouse survey area. Surveys comprised dormouse footprint tunnel surveys undertaken in accordance with current guidance[59].

7.4.43. Further detail about the dormouse surveys is included in Technical Appendix 7.4 – Dormouse Survey (Aapplication document TR010063—/-APP/-6.15).

Badger

7.4.44. A targeted badger survey was carried out between November 2020 and January 2021 in accordance with good practice guidance[60]. The extent of the badger survey included all land within the Scheme boundary and a 50 m buffer extending out in all directions from the Scheme Boundary where access allowed. The area was inspected for evidence of badger activity including setts, latrines, dung pits, prints, foraging scrapes, pathways,

[58] Natural England Standing Advice: Hazel or common dormice: surveys and mitigation for development projects, accessed May 2019 from: https://www.gov.uk/guidance/hazel-or-common-dormice-surveys-and-mitigation-for-development-projects
[59] Simone Bullion and Alison Looser (June 2019). Guidance for using Hazel Dormouse Footprint Tunnels. Suffolk Wildlife Trust.
[60] Harris, S., Cresswell, P. & Jefferies, D. (1989) Surveying Badgers. Occasional Publication No.9. The Mammal Society.

hairs, and scratching posts. Any setts identified during the surveys were classified as either a main, annexe, subsidiary or outlier sett.

7.4.45. Evidence of badger was also recorded during the extended Phase 1 habitat survey undertaken along the verges of the M5 motorway in September 2021. An update survey of previously recorded badger setts potentially impacted by the Scheme, was undertaken in April 2022 to ascertain the activity level and update the classification of these setts as necessary. In addition, signs of badger were recorded incidentally during other surveys, in particular the extended Phase 1 habitat surveys undertaken in May and September 2019 and habitat surveys in May 2022.

7.4.46. Further detail about the badger surveys is included in the confidential Technical Appendix 7.5 – Badger Survey A((applicationApplication document TR010063—/-APP/-6.15).

Otter

7.4.47. Otter habitat suitability assessments were carried out in September and November 2019, and in March and July 2021. These surveys assessed the suitability of habitats within the study area to provide habitat for otters, considering the water level, food supply, visible pollution levels, levels of disturbance, connectivity, and places for resting and sheltering. Otter presence / likely absence surveys were carried out between September and November 2019, and in June and July 2020. The surveys were undertaken following good practice methodologies and were based on otter survey protocols set out in Chanin (2003)[61]. 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. Further detail about the otter surveys is included in Technical Appendix 7.6 – Otter Survey (Aapplication document TR010063—/-APP/-6.15).

Water vole

7.4.48. Water vole habitat suitability assessment surveys were carried out in September and November 2019 and in March and July 2021 according to good practice guidance[62,63]. 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 of suitable habitat features in June 2020, covering sections of the River Chelt and one minor watercourse. The habitat features which were surveyed in November 2019 were scoped out from further assessment (due to unsuitable habitat) and therefore presence / likely absence surveys for water vole were not undertaken here in 2020. Further detail about the water vole surveys is included in Technical Appendix 7.7 – Water Vole Survey (A((application document TR010063—/-APP/ 6.15).

Breeding and wintering birds (excluding barn owl)

7.4.49. Breeding bird surveys were undertaken on four occasions in June and July 2019, May 2020 and April 2021. The principles of the Common Birds Census (CBC) mapping methodology developed by the British Trust for Ornithology (BTO) were broadly followed[64]. 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 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[65]. Further detail about the breeding bird

[61] Chanin, P. (2003). Monitoring the otter *Lutra lutra*. Conserving Natura 2000 Rivers Monitoring Series No 10. Peterborough, English Nature.
[62] Strachan, R. & Moorhouse, T. (2011). Water Vole Conservation Handbook (3rd edition). Wildlife Conservation Research Unit, University of Oxford.
[63] Dean, M. et al (2016) The Water Vole Mitigation Handbook. Mammal Society.
[64] Gilbert, G., Gibbons, D.W. & Evans, J. (1998) Bird monitoring methods: A manual of techniques for key UK species. RSPB: Sandy.
[65] For this assessment, priority 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

surveys is included in Technical Appendix 7.8 – Breeding Bird Survey (Aapplication document TR010063-/-APP/-6.15).

7.4.50. Wintering bird surveys were undertaken each month from September 2019 to March 2020 inclusive. The wintering bird survey method used involves recording all birds on a map as with a CBC 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 species of conservation concern. Six representative transects of varying lengths were surveyed, which gave suitable coverage of the study area. Further detail about the wintering bird surveys is included in Technical Appendix 7.9 – Wintering Bird Survey (Aapplication document TR010063-/-APP/-6.15).

Barn owl

7.4.51. During the bat building and tree surveys, the identification of features potentially suitable for nesting, roosting or foraging barn owl was undertaken. Incidental records of barn owl were also collected during other surveys.

7.4.52. Targeted barn owl surveys were undertaken between March and July 2022. The survey methodology was based on best practice guidelines[66]. The survey area for barn owl included the Scheme Boundary and an area extending up to 1.5 km from the Scheme Boundary. Unsuitable areas for barn owl, such as urban habitats, major infrastructure, dense woodland and agricultural areas with no potential nesting sites or foraging habitat were screened out from field surveys. A walkover survey was then undertaken within areas that had not been screened out. This aimed to broadly establish and record additional landscape features which may be of potential value to barn owls, including built structures and trees that could be used as breeding and roosting sites and potential foraging habitats. This was largely undertaken from clear vantage points located on public rights of way, farm tracks and field margins, where the landscape could be scanned using binoculars.

7.4.53. The structures and trees identified were inspected from the ground to determine whether they possessed a suitable cavity or chamber and therefore categorised as a potential nest site (PNS) or were not suitable for nesting but had signs of use indicating an active roost site (ARS) or temporary roost site (TRS). In addition, habitats were assessed in more detail for their suitability to support foraging barn owl.

7.4.54. Subsequently, the PNS were subject to detailed inspection to determine whether they were actively used by barn owls for breeding, or if they had been in the recent past. Such inspections were undertaken between mid-June and mid-August 2022 by an appropriately licensed ecologist.

7.4.55. Further detail about the barn owl surveys is included in Technical Appendix 7.16 – Barn Owl Survey (Aapplication document TR010063-/APP-/6.15).

Reptiles

7.4.56. An initial reptile habitat suitability assessment was undertaken in May and September 2019 during the initial extended Phase 1 habitat surveys.

7.4.57. Presence / likely absence surveys for widespread species of reptile[67] were carried out between September and October 2019, August and October 2020 and September and

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.

[66] Shawyer, C. R., (2011). Barn Owl Survey Methodology and Techniques for use in Ecological Assessment. Developing Best Practice in Survey and Reporting. Available at:

[redacted]

[67] Due to the restricted ranges of smooth snake and sand lizard, these species are not considered within this report.

October 2021 with reference to available survey guidance[68,69,70]. Artificial refuges, consisting of roofing felt and corrugated metal sheets ('tins') measuring approximately 0.5 m^2, were laid out in 26 survey transects within suitable habitat. Seven checks of the artificial refuges were undertaken in suitable weather conditions. Further detail about the reptile surveys is included in Technical Appendix 7.10 – Reptile Survey (Aapplication document TR010063-/-APP/-6.15).

Great crested newt

7.4.58. In June 2019, June 2020 and May and June 2021, great crested newt habitat suitability surveys and environmental DNA (eDNA) surveys were undertaken of all accessible waterbodies within 500 m of the Scheme. The habitat suitability survey followed the HSI methodology developed by Oldham *et al*. (2000)[71]. eDNA survey followed the Natural England approved methodology described by Biggs *et al*. (2014)[72]. Water samples were collected from each pond and sent to ADAS or SureScreen Scientifics[73] for laboratory analysis. Further detail about the great crested newt surveys is included in Technical Appendix 7.11 – Great Crested Newt Survey (Aapplication document TR010063-/-APP/6.15).

Aquatic habitats and species

7.4.59. Separate site walkover surveys have been undertaken to inform the assessment of aquatic habitats and species. The requirement for including specific aquatic habitats in the walkover was determined based on the potential Scheme interactions and associated impacts. Only those features for which impacts are considered likely to occur were screened in for walkover survey.

7.4.60. The aquatic walkover survey, undertaken on 23 and 24 July 2019, focused around the point of interaction with the Scheme (i.e. proposed crossing point of a watercourse) and, where feasible, 250 m up and downstream of these interactions.

7.4.61. During the walkover survey, habitat characteristics were recorded broadly following habitat descriptors outlined in the RHS methodology[74], which includes substrates, vegetation types, flow types, approximate channel dimensions and presence of artificial features (channel/bank re-sectioning and/or existing crossing structures, weirs or outfalls). Further detail about the aquatic ecology surveys is included in Technical Appendix 7.12 – Aquatic Ecology Survey (applicationApplication document TR010063-/APP/-6.15).

7.4.62. MoRPh was used to assess river habitat condition of the Leigh Brook and River Chelt, during May and July 2022, respectively. The MoRPh method[75] is a quantitative visual geomorphological assessment of a river and riparian zone that records a list of features which are marked as extensive, present, trace or absent based on their extent across the survey reach. Such features include elements such as channel form, in-channel habitats (e.g., riffles, pools, berms), bed substrates, bank material as well as flow types. Broad

[68] Froglife (1999) Reptile Survey: an introduction to planning, conducting and interpreting surveys for snake and lizard conservation. Froglife advice sheet 10.
[69] Highways England (2020). Design Manual for Roads and Bridges. LD 118 Biodiversity Design (formerly LA 118 which superseded HA 59/92, HA 67/93, HA 80/99, HA 81/99, HA 84/01, HA 97/01, HA 98/01, HA 116/05, UAN 116/08, IAN 116/08(W)) (March 2020, version 0) Online: https://www.standardsforhighways.co.uk/dmrb/search?discipline=SUSTAINABILITY_AND_ENVIRONMENT
[70] Sewell D., Griffiths R., Beebee T., Foster J., & Wilkinson J. (2013). Survey protocols for the British herpetofauna. Version 1.0.
[71] 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.
[72] 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.
[73] 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.
[74] 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.
[75] Details of the method can be found [redacted]

aquatic ecological plant community structure and characteristics of the bankside and riparian zone were also recorded.

7.4.63. Following review of background records, other scheme data, and observations from the walkover survey, further detailed aquatic species and habitat surveys were undertaken on watercourses which exhibited suitable habitat considered likely to support valuable assemblages of aquatic species. These surveys comprised the following:

- RHS[76] undertaken in July 2020.
- River Corridor Survey (RCS)[77] undertaken in July 2020.
- Aquatic macroinvertebrates[78] undertaken in October 2020.
- Aquatic macrophytes (LEAFPACS)[79] undertaken in July 2020.
- Fish (electric fishing)[80] undertaken in July 2020.

7.4.64. White clawed crayfish surveys were undertaken in July 2020 of the River Chelt and Leigh Brook, comprising visual assessment of available habitat features. At sites that were suitable (along the River Chelt), a manual search of refuge habitats within five patches along the reaches surveyed for RHS and RCS was undertaken following standard survey methodology[81]. All white-clawed crayfish surveys were led by surveyors holding a Natural England Class Survey Licence (CL11). During the surveys, information was recorded on the site length, channel width, flow, water clarity, water temperature, water quality, and shading, as well as information on the types of refuges present for searching and the presence of any crayfish burrows.

Biodiversity Net Gain

7.4.65. The Natural England Biodiversity Metric provides a way of measuring and accounting for biodiversity losses and gains resulting from development and/or land management change.

7.4.66. A BNG assessment has been undertaken using this metric to review whether the Scheme provides a net gain in biodiversity units for terrestrial habitats, hedgerows and rivers and streams. The assessment sets out the pre-construction baseline and predicted post-development biodiversity unit data for the Scheme.

7.4.67. As per the methodology set out by Natural England for the assessment of BNG[82], assessments are made separately for rivers and streams, terrestrial habitats (habitats), and hedgerows. Therefore, for a project such as this Scheme, where all three of these typologies are present, the BNG assessment covers these three different elements to produce three BNG net change values.

7.4.68. Initially, a BNG feasibility assessment was undertaken in early 2022. This was an interim, high-level assessment to inform ongoing discussions around habitat creation and mitigation options, ensuring an iterative design process. It was based on an earlier design

[76] Environment Agency, 2003. River Habitat Survey in Britain and Ireland. Field Survey Guidance Manual.
[77] National Rivers Authority, 1992. River Corridor Surveys: Methods and Procedures. Conservation Technical Handbook.
[78] Aquatic macroinvertebrate samples were collected using a standard three-minute kick-sampling technique in accordance with River Invertebrate Prediction & Classification Systems (RIVPACS) standard sampling protocols. RIVPACS is the model implemented within the RICT (River Invertebrate Classification Tool) used by the Environment Agency to determine WFD invertebrate classifications. Reference: EU Star UK (2006) RIVPACS Macroinvertebrate Sampling Protocol. Available at: [redacted])
[79] UKTAG, 2014. Guide to Macrophytes in Rivers River LEAFPACS2. [pdf] Available at: [redacted]
[80] UKTAG (2008). River Assessment Methods: Fish Fauna (Fisheries Classification Scheme 2) by Water Framework Directive - United Kingdom Technical Advisory Group (WFD-UKTAG): [redacted]
[81] Peay S (2003). Monitoring the White-clawed Crayfish Austropotamobius pallipes. Conserving Natura 2000 Rivers Monitoring Series No. 1, English Nature, Peterborough.
[82] Panks, S., White, N., Newsome, A., Potter, J., Heydon, M., Mayhew, E., Alvarez, M., Russell, T., Scott, S.J., Heaver, M., Scott, S.H., Treweek, J., Butcher, B. and Stone, D. (2021). Biodiversity metric 3.0: Auditing and accounting for biodiversity – User Guide. Natural England.

(Design Fix 2), and used existing Phase 1 habitat survey data, converted to the UK Habitat (UKHab) classification system to calculate the baseline biodiversity units. A number of other assumptions and limitations were also made.

7.4.69. During the Phase 1 habitat validation survey in May and June 2022, habitats were recorded using the UKHab classification system. UKHab is the classification system that Biodiversity Metric 3.0 predominantly uses for terrestrial area habitats. Habitat condition scores of good, moderate or poor were assigned with reference to the relevant condition criteria for each habitat type as set out within the Biodiversity Metric 3.0 Technical Supplement[83].

7.4.70. The BNG feasibility assessment has been updated to incorporate Design Fix 3, to reflect the final preliminary Scheme design, and using UKHab data to calculate the baseline biodiversity units.

7.4.71. Further detail about BNG is included in Technical Appendix 7.18 – Biodiversity Net Gain (Aapplication document TR010063—/-APP/-6.15). The results of the BNG assessment are summarised in the Summary section of this Biodiversity chapter.

Age of survey data

7.4.72. As discussed in the sections above, ecological survey data collection began in 2019, and has continued to 2022. Although a large proportion of the survey data was collected in 2019 and 2020, update/validation surveys continued in 2021 and 2022.

7.4.73. This included Phase 1 habitat validation surveys undertaken in 2022. The purpose of these validation surveys was to update the Phase 1 habitat data as necessary; and to determine whether any of the baseline conditions have changed significantly, and validate, or otherwise, the results ~~described~~described, and conclusions drawn in relation to a number of ecological receptors.

7.4.74. The validity of the survey data for each receptor is discussed in Technical Appendix 7.17 – Validation Report (~~application~~Application document TR010063—/-APP-/6.15).

Limits of deviation

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

7.5. Consultation

7.5.1. A non-statutory consultation took place in the Autumn of 2020. The preferred route, informed by the responses to the non-statutory consultation was announced on 16 June 2021, and a statutory public consultation took place between December 2021 and February 2022. Further targeted consultation was undertaken in August to September 2022, December 2022 to February 2023, and May to June 2023, to cover changes in the design since the statutory consultation, with information provided to prescribed consultees, affected landowners, and to the informal Traveller site. This assessment takes account of relevant comments raised during the consultation.

[83] Panks, S., White, N., Newsome A., Potter. J., Heydon M., Mayhew, E., Alvarez, M., Russell. T., Scott, S.J., Heaver, M., Scott, S.H., Treweek, J., Butcher, B. & Stone, D. (2021). Biodiversity metric 3.0: Auditing and accounting for biodiversity – Technical Supplement. Natural England.
Biodiversity Metric 3.1, an update to the previously published biodiversity metric 3.0, was published on 21.04.2022, and Biodiversity Metric 4.0 was published in March 2023. However, for this Scheme, given that metric 3.0 was used to undertake an initial BNG feasibility assessment at the start of 2022, version 3.0 will continue to be used, and has been used to undertake the calculations. This is in line with advice from Natural England (Natural England Joint Publication JP039 (April 2022) Biodiversity Metric 3.1 Frequently Asked Questions).

7.5.2. Key consultees for biodiversity are Natural England and the Environment Agency. As well as being consulted during the statutory and non-statutory consultation process, dialogue with both stakeholders has been ongoing since 2020.

7.5.3. Details of all consultation can be found in the Consultation Report (Aapplication document TR010063—/APP/-5.1 and TR010063—/-APP/-5.2). A summary of key points is included in the following paragraphs.

7.5.4. Early consultation meetings with the Environment Agency were undertaken on 16 January 2020 and 15 July 2021.

7.5.5. Further to these meetings, the Environment Agency provided consultation responses outlining key points for consideration. These included the need for consideration of connectivity to downstream watercourses and functionally linked habitats; presence of protected and notable species, including migratory and non-migratory fish species; opportunities for enhancements to aquatic habitats (watercourses and wetlands); and the need for a Water Framework Directive (WFD) compliance assessment.

7.5.6. Key aspects of the consultation with Natural England are outlined in Table 7-5 below:

Table 7-5 - Consultation with Natural England (unless otherwise stated, the method of communication was via email)

Date	Matters Ddiscussed (note, unless a cross reference to an application document is provided, the reports referred to here do not form part of the application).
02.12.2020	A package of information was provided to Natural England, including: • M5 Junction 10 Improvements Scheme Habitats Regulations Assessment (HRA) Screening Report (16/12/19). • M5 J10 Improvements Scheme Natural England Consultation (November 2020). This). This document provided an overview of the desk study and surveys undertaken to September 2020; identified any limitations encountered; summarised the results of the desk study and survey work and provided a preliminary valuation for each biodiversity resource. It also discussed proposed further survey work and posed specific questions to Natural England.
16.04.2021	Comments were received from Natural England on the above package of information. Natural England agreed on: • The bat survey work presented at that time. • The approach to great crested newts. • The proposed approach to address some of the older survey data. Natural England also commented that other species surveys appeared to be in line with relevant guidance. Regarding the HRA, Natural England commented: • That it does not consider that likely significant effects can be ruled out based on migratory functionally linked species of the Severn Estuary SAC/Ramsar Site, specifically fish, including European eel. • That it does not consider that effects on the Severn Estuary SPA and Walmore Common SPA can be ruled out based on the information provided. In particular, the narrative around functionally linked land should be strengthened. • That the conclusion that there would be no impacts on the Wye Valley and Forest of Dean Bat Sites SAC should be strengthened by considering any commuting/foraging routes.

Date	Matters Ddiscussed (note, unless a cross reference to an application document is provided, the reports referred to here do not form part of the application).
	• That a number of fish species had been omitted from the Severn Estuary SAC/Ramsar Site list of qualifying features, and that the Environment Agency should be consulted. • That the narrative around screening out effects on the downstream Severn Estuary designations as a result of distance and dilution should be strengthened. • That air quality effects need further consideration.
27.07.2021	A response to Natural England's comments was provided, and the comments on the HRA were addressed in the HRA that supported the PEIR, which has been updated again to support this ES (Technical Appendix 7.13 – Habitats Regulations Assessment – Screening (applicationApplication document TR010063/--APP/-6.15) and Technical Appendix 7.14 - Statement to Inform an Appropriate Assessment (SIAA) ([application document TR010063--/-APP/-6.15]}). The following document was also provided to Natural England along with the response: M5 Junction 10 Improvements Scheme Bat Survey Protocol (23/07/21). This document details the methodology for the bat surveys. An Addendum to this document was provided on 07.07.2022.
06.12.2021	Consultation materials were sent to Natural England for comment.
15.02.2022 – representation from Natural England was received 29.03.2022 – Natural England provided further comments on the PEIR	Following the statutory consultation, Natural England commented that potential for recreational pressure to the Cotswold Beechwoods SAC and Coombe Hill Canal SSSI should be considered, and that the latter has been shown to be functionally linked to the Severn Estuary SPA. Gloucestershire Wildlife Trust also commented on the potential for recreational pressure on Coombe Hill Canal SSSI. These matters have been addressed in the updated HRA (Technical Appendix 7.13 – Habitats Regulations Assessment – Screening [{applicationApplication document TR010063/--APP/-6.15] }-and Technical Appendix 7.14 -– Statement to Inform an Appropriate Assessment (SIAA) [{applicationApplication document TR010063/--APP/-6.15]}).
07.04.2022	Atkins followed up on comments made by Natural England and asked whether Natural England would like to review and comment on the addendum to the bat survey protocol.
10.06.2022	Atkins provided Natural England with a link to the HRA which supported the PEIR and confirmed that the HRA had been updated to incorporate Natural England's comments received in April 2021. Atkins advised Natural England that the HRA would be updated again for submission with the ES. A document outlining survey work proposed / currently underway in 2022 was provided to Natural England for comment. The document also reviewed the study areas and ecological zones of influence of all biodiversity resources, for Natural England's comment.
10.10.2022	Natural England responded that they were in agreement with the proposal not to survey the stretches of the M5 verge outside of the highway alignment, but within the Order limits. These extend approximately 2 km north and 2 km south of the highway alignment. Atkins advised Natural England that the Bat Survey Protocol Addendum would follow (it followed on 07.07.2022). Atkins advised Natural England on timescales for draft protected species licences.

Date	Matters Ddiscussed (note, unless a cross reference to an application document is provided, the reports referred to here do not form part of the application).
07.07.2022	Atkins provided Natural England with the Bat Survey Protocol Addendum report. (M5 Junction 10 Improvements Scheme Bat Survey Protocol Addendum (06/07/2022). Atkins provided an update to timescales for draft protected species licences.
05.08.2022	Atkins provided Natural England with draft bat and badger mitigation licences for review and comment.
03.11.2022	Meeting (on Teams) with Natural England Licensing Team to discuss the draft bat licence. A number of items were discussed. Natural England's key concern was around how gaps in the bat roost survey data have been addressed. Minutes of the meeting were circulated on 10.11.2022 for review and comment.
07.11.2022	The updated HRA was provided to Natural England (Technical Appendix 7.13 – Habitats Regulations Assessment – Screening ~~([~~Aapplication document TR010063~~/APP/6.15 APP 6.15])~~ and Technical Appendix 7.14 - Statement to Inform an Appropriate Assessment (SIAA) ~~([~~Aapplication document TR010063~~/--~~APP~~/~~6.15~~])~~). On 09.11.2022 Natural England responded that it is in agreement with the conclusion that likely significant effects on the Severn Estuary SPA and Walmore Common SPA can be ruled out; and that likely significant effects as a result of air quality impacts can be ruled out. Furthermore, having reviewed the HRA, Natural England advised that in these circumstances it is appropriate to rely on the HRA of the planning applications for the unlocked housing developments to ascertain whether the road improvement will have an adverse effect on the integrity of the European Sites with regard to recreational pressure. Comments from Natural England's freshwater team were received on 30.11.2022. Overall, Natural England agree with the conclusion of no adverse effects on the integrity of the Severn Estuary designations, however a number of points were raised which have now been addressed in Technical Appendix 7.14 - Statement to Inform an Appropriate Assessment (SIAA) (Aapplication document TR010063~~/--~~APP~~/~~6.15).
08.11.2022	Information about an area of lowland meadow priority habitat was provided to Natural England, including the broad approach to compensating for loss of a small area of this habitat. On 14.11.2022 Natural England responded that it agrees with the broad proposals and provided some additional minor comments. Atkins provided Natural England with the draft dormouse mitigation licence.
05.12.2022	Atkins sent documents (M5 Junction 10 Improvements Scheme Refined Bat Roost Impact Assessment (05/12/2022) and (M5 Junction 10 Improvements Scheme Bat Roosts Impact Assessment (05/12/2022) which detailed the revised process undertaken, to address gaps in the bat roost survey data raised by Natural England via a Teams meeting on 03.11.2022.

Date	Matters Ddiscussed (note, unless a cross reference to an application document is provided, the reports referred to here do not form part of the application).
13.12.2022	Atkins sent document (M5 Junction 10 Improvements Scheme Compensatory Bat Roosts (12/12/2022) which provides more information about the compensatory roost structures proposed, to address comments raised by Natural England via a Teams meeting on 03.11.2022.
16.01.2023	As part of the further targeted consultation, consultation materials were sent to Natural England for comment. A meeting (virtual via Teams) was held with Natural England on 17.01.2023 to discuss the proposed changes to the Scheme, summarised within the further targeted consultation materials. On 18.01.2023 representation was received from Natural England, in relation to the further targeted consultation. Natural England confirmed that the changes do not alter any of the advice previously provided.
20.01.2023	Natural England provided comments on the Refined Bat Roost Impact Assessment sent to them on 05.12.2022.
26.01.2023	Atkins provided an initial response to the Natural England's comments of 20.01.2023. Natural England provided comments on the draft badger licence, including a list of conditions to be included on the Letter of No Impediment (LoNI).
27.01.2023	Meeting (virtual via Teams) to discuss the comments provided via email on 20.01.2023, on the approach to bats.
30.01.2023	Atkins emailed Natural England a summary of the key actions and outcomes from the meeting on the 27.01.2023.
09.02.2023	Atkins sent an updated version of the Refined Bat Roost Impact Assessment to Natural England to address comments received via email on 20.01.2023 and in the meeting on 27.01.2023.
20.02.2023	Natural England provided comments on the draft dormouse licence, including a list of conditions to be included on the LoNI,
28.02.2023	Atkins confirmed agreement with the conditions to be included in the LoNI for badgers and dormice and requested that the LoNIs are provided as soon as possible.
21.03.2023	Atkins provided Natural England with an updated HRA SIAA, which has been updated to address comments from Natural England's freshwater team (received on 30.11.2022), as well as comments received during client/legal/National Highways review. Natural England confirmed on 02.05.2023 that they are satisfied comments had been addressed.
30.03.2023	Natural England provided Atkins with a badger LoNI
31.03.2023	Atkins provided Natural England with a figure which provides more detail about the developments surrounding the M5J10 Scheme, as well as the draft bat licence Application Form with the 'named ecologist' section completed. The intention is for these documents to help progress the draft bat licence.
14.04.2023	Natural England provided Atkins with a dormouse LoNI.

Date	Matters Ddiscussed (note, unless a cross reference to an application document is provided, the reports referred to here do not form part of the application).
26.04.2023	Meeting with Natural England (virtual via Teams) to discuss bats and the Statement of Common Ground. Meeting minutes and key points were circulated on 05.05.2023, including a proposed way forward with regard to the LONI.
16.05.2023	Further Information Request received from Natural England in relation to the draft bat licence. Further clarification was provided by Natural England on 17/05/2023. This clarified that Natural England's key comment in the Further Information Request was around compensation for low conservation value roosts that will/are predicted to experience temporary disturbance. On 19/05/2023 Atkins provided a response to Natural England to address this key comment.
16.05.2023	The following parts of the ES were provided to Natural England for comment: • Environmental Statement Chapter 2 – Scheme Description • Environmental Statement Chapter 7 – Biodiversity • Environmental Statement Chapter 5 – Air Quality • Register of Environmental Actions and Commitments • Environmental Masterplans
25.05.2023	As part of the Further Targeted Consultation on the proposed bus lane, consultation materials were sent to Natural England for comment via email.
30.05.2023	Natural England commented on the proposed way forward to secure the LoNI for bats set out in the email on 05.05.2023. On 12.05.2023 Atkins responded and posed a number of queries to Natural England.
12.06.2023	Representation received from Natural England, in relation to the Further Targeted Consultation on the proposed bus lane.
23.06.2023	Comments received from Natural England on the Biodiversity and Air Quality chapters.
18.07.2023	Natural England provided further comment on the compensation proposed for bats, following correspondence on 19.05.2023.
19.07.2023	Meeting with Natural England (virtual via Teams). Atkins and Natural England discussed the email from 18.07.2023, the 2023 bat survey work, the next steps with regard to the LoNI for bats and the Statement of Common Ground.

7.6. Baseline conditions

7.6.1. The paragraphs below provide a summary of the results of the baseline surveys undertaken, and an assessment of the importance of the biodiversity resources broadly following the geographical framework provided in LA 108. Further information on species and habitat specific surveys are detailed within the Technical Appendix reports (Appendices 7.1 to 7.18 [(Aapplication document TR010063/—APP 6.15]); a summary is provided here.

Designated sites

7.6.2. European designated sites are shown on Figure 7-13A in Technical Appendix 7.13 – Habitats Regulations Assessment – Screening [(Aapplication document TR010063—/

APP/-6.15). All other designated sites are shown on Figure 7-1B in Technical Appendix 7.1 – Phase 1 Habitat Survey (Aapplication document TR010063—/AAPP/-6.15).

Wye Valley and Forest of Dean Bat Sites SAC

7.6.3. The Wye Valley and Forest of Dean Bat Sites SAC is located within 30 km of the Scheme and supports bats as qualifying features. The SAC 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 (supporting 6% of the UK population). The nearest of the SAC components (Blaisdon Hall SSSI) is located approximately 21 km west of the Scheme.

7.6.4. This SAC has been ascribed a value of International importance.

Severn Estuary SAC/SPA/Ramsar Site

7.6.5. The Severn Estuary is designated as a SAC, SPA and a Ramsar Site. All of the watercourses which are crossed by the Scheme (River Chelt, Leigh Brook, and their tributaries) eventually flow into the River Severn, which is approximately 7.5 km downstream from their closest Scheme interaction. From the nearest confluence point, where the River Chelt joins the River Severn, just upstream of Wainlode Cliff, the Severn Estuary designations are a further 40 km downstream.

7.6.6. Qualifying features of the SAC comprise:

- 1130 Estuaries – one of the best areas in the UK.
- 1140 Mudflats and sandflats not covered by seawater at low tide – one of the best areas in the UK.
- 1330 Atlantic salt meadows– one of the best areas in the UK.
- 1110 Sandbanks which are slightly covered by seawater all the time – the site is thought to support a significant presence of this habitat.
- 1170 Reefs – the site is thought to support a significant presence of this habitat.
- 1095 Sea lamprey– one of the best areas in the UK.
- 1099 River lamprey– one of the best areas in the UK.
- 1103 Twaite shad – one of the best areas in the UK.

7.6.7. Qualifying features of the SPA comprise:

- This site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of European importance of the following species listed on Annex I of the Directive over winter:
  - Bewick's swan – 280 individuals representing 3.9% of the GB population (5 year peak mean 1991/2 - 1995/6).
- The site also qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species over winter:
  - Gadwall – 282 individuals representing 0.9% of the population (5 year peak mean 1991/2 - 1995/6).
  - European white-fronted goose – 2,664 individuals representing 0.4% of the population (5 year peak mean 1991/2 - 1995/6).
  - Dunlin – 44,624 individuals representing at least 3.3% of the population (5 year peak mean 1991/2 - 1995/6).
  - Shelduck – 3,330 individuals representing 1.1% of the population (5 year peak mean 1991/2 - 1995/6).
  - Redshank – 2,330 individuals representing 1.3% of the population (5 year peak mean 1991/2 - 1995/6).

- Ringed plover on passage[84].

- The site also qualifies under Article 4.2 of the Directive (79/409/EEC) for supporting an internationally important assemblage of birds. Over winter the site regularly supports 84,317 waterfowl (5 year peak mean 1991/2 - 1995/6). The most recent Natura 2000 Standard Data Form for the Severn Estuary SPA does not include a list of species which make up the waterfowl assemblage. However, the 2001 SPA Review[85] listed 12 species in addition to the 'SPA qualifying species' listed above, as follows (wigeon, teal, mallard, pintail, shoveler, pochard, tufted duck, grey plover, lapwing, whimbrel, curlew, spotted redshank).

7.6.8. Qualifying features of the Ramsar Site comprise[86]:

- Estuarine habitats (Ramsar Criterions 1 and 3).
- Migratory fish (Ramsar Criterions 4 and 8) including:
  - Atlantic salmon
  - Sea trout
  - Sea lamprey
  - River lamprey
  - Allis shad
  - Twaite shad
  - European eel
  - The fish of the whole estuarine and river system is one of the most diverse in Britain, with over 110 species recorded. Salmon, sea trout, sea lamprey, river lamprey, allis shad, twaite shad and European eel use the Severn Estuary as a key migration route to their spawning grounds in the many tributaries that flow into the estuary[87]. The site is important as a feeding and nursery ground for many fish species particularly allis shad and twaite shad. In addition, the Severn Estuary has the largest European eel run in Great Britain[87].
- Internationally important populations of wintering birds (Ramsar Criterion 6) including:
  - Tundra swan
  - Bewick's swan
  - White fronted-goose
  - Shelduck
  - Gadwall
  - Dunlin
  - Common redshank
- Wintering waterfowl assemblage of international importance (Ramsar Criterion 5).
- Breeding lesser black-backed gull was identified subsequent to designation for possible future consideration under Ramsar Criterion 6 – 4,167 apparently occupied nests representing an average of 2.8% of the western Europe/Mediterranean/west African breeding population (Seabird 2000 Census).

The Severn Estuary SAC/SPA/Ramsar Site has been ascribed a value of International importance.

Walmore Common SPA/Ramsar Site

7.6.9. Walmore Common SPA/Ramsar Site has been included as there is the potential for functionally linked land associated with this European Site to be affected by the Scheme.

[84] Although not included on the most recent update of the Natura 2000 Standard Data Form for the Severn Estuary SPA, ringed plover is included here because the 2009 advice issued under Regulation 33(2)(a) of the Conservation of Natural Habitats and Species Regulations 1994 (as amended) lists this species as a qualifying species added during the 2001 SPA Review[21].
[85] Stroud, D.A., Chambers, D., Cook, S., Buxton, N., Fraser, B., Clement, P., Lewis, P., McLean, I., Baker, H. & Whitehead, S. (eds) (2001). *The UK SPA Network: Its Scope and Content*. JNCC, Peterborough.
[86] https://jncc.gov.uk/jncc-assets/RIS/UK11081.pdf
[87] Natural England and the Countryside Council for Wales (2009). The Severn Estuary/Mor Hafren European Marine Site

Walmore Common SPA/Ramsar 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.

7.6.10. Walmore Common SPA/Ramsar Site has been ascribed a value of International importance.

Cotswold Beechwoods SAC

7.6.11. One of the objectives of the Scheme is to unlock the proposed housing developments in the area by providing the necessary highways infrastructure. The statutory consultation comments (as outlined in Table 7-5 in Section 7.5) raised the possibility that, in turn, this could result in increased recreational pressure on the Cotswold Beechwoods SAC.

7.6.12. The Cotswold Beechwoods SAC is located 7.4 km south of the Scheme. The site consists of ancient beech woodland and unimproved grassland. The woodlands are amongst the most diverse and species-rich of their type, and the grasslands typify the unimproved calcareous pastures for which the area is famous. Qualifying features of the SAC comprise:

- 9130 *Asperulo-Fagetum* beech forests (Beech forests on neutral to rich soils).
- 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (Dry grasslands and scrublands on chalk or limestone).

7.6.13. Cotswold Beechwoods SAC has been ascribed a value of International importance.

Coombe Hill Canal SSSI

7.6.14. Coombe Hill Canal SSSI 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 scarce plants. This site is located approx. 1.9 km north west of the Scheme.

7.6.15. Coombe Hill Canal SSSI has been ascribed a value of National importance.

Non-statutory sites

7.6.16. There is one unconfirmed, or potential, non-statutory designated Local Wildlife Site within 1 km of the Scheme Boundary: Hayden Sewage Treatment Works, located approximately 680 m south of the Scheme Boundary (see Figure 7-1B in Appendix 7.1 [{Aapplication document TR010063/3–APP/–6.15]}). The site is of interest because of the birds and –hedgerows it supports. Hayden Sewage Treatment Works is also located within 200 m of the ARN.

7.6.17. There are six additional non-statutory designated nature conservation sites within 200 m of the ARN:

- Norton (A38) Conservation Road Verge – a wide band of dwarf elder, with rough grassland, tall herb and hedgerow.
- Pegmore Farm, The Leigh 'Meadow 2' potential LWS – a diverse wet meadow grassland.
- Cotswold Farm, The Leigh Conservation Road Verge – a stand of dwarf elder within tall herb and rank grassland, with encroaching scrub and tree saplings.
- Tewkesbury Nature Reserve potential LWS – a nature reserve important to the local community.
- Tewkesbury Railway Line (Disused) LWS – an area with invertebrate interest, specifically glow worm.
- Walton Cardiff Ponds LWS – an area with amphibian interest, specifically great crested newt.

7.6.18. The above mentioned non-statutory designated nature conservation sites have each been ascribed a value of County importance.

Terrestrial habitats

7.6.19. There are no recorded ancient woodlands within 1 km of the Scheme Boundary, nor within 200 m of the ARN.

7.6.20. There is one record of an ancient or veteran tree within 1 km of the Scheme Boundary, a common yew 950 m east of the northern extent of the Scheme. The arboricultural survey report for the Scheme was reviewed which identified one veteran ash tree in a hedgerow within the southern quadrant of the Scheme Boundary, approximately 50 m east of Withybridge Lane. There are no recorded ancient or veteran trees within 200 m of the ARN. The ancient/veteran trees are considered to be a resource of National importance for biodiversity.

7.6.21. Priority habitat records identified during the desk study within 1 km of the Scheme Boundary comprise:

- Deciduous woodland and traditional orchards within the Scheme Boundary.
- Open mosaic habitat on previously developed land 180 m north of the Scheme Boundary.
- Coastal and floodplain grazing marsh approximately 680 m west of the Scheme Boundary.

7.6.22. The Scheme is located within a low-lying, mainly agricultural landscape to the north west of Cheltenham. The 200 m study area was dominated by arable fields, improved grassland and species-poor semi-improved grassland. The dominant arable and grassland habitats were interspersed with pockets of other terrestrial habitats of greater nature conservation value, including broadleaved and mixed plantation woodland, broadleaved semi-natural woodland, scrub, traditional orchard, semi-improved neutral grassland, unimproved neutral grassland and hedgerows. While aquatic habitats are evaluated separately, the proximity of the terrestrial habitats to aquatic habitats and the connectivity provided by the aquatic habitats is considered to enhance the overall value of the terrestrial habitats.

7.6.23. Traditional orchards were recorded at Stanboro Lane (approximately 40 m north of the Scheme Boundary), Millhouse Farm (approximately 100 m west of the Scheme Boundary) and Hayden Hill Fruit Farm (approximately 60 m south-east of the Scheme Boundary). A single copse of broadleaved semi-natural woodland was recorded approximately 80 m south of the Scheme Boundary. Two areas of unimproved neutral grassland were recorded; one within the roadside verge north of Stanboro Lane (0.07 ha in size), and another in the verge south of the A4019 west of the M5 Junction 10 (0.1 ha in size). Both areas of unimproved neutral grassland are within the Scheme Boundary. These areas of traditional orchard, broadleaved semi-natural woodland and unimproved neutral grassland meet the criteria for the priority habitat types: traditional orchard[88], lowland mixed deciduous woodland[89] and lowland meadow[90] respectively. The fields across the study area were typically bordered by species-poor hedgerows. Results from the hedgerow surveys indicate that, of the 129 hedgerows surveyed, a total of 121 meet the criteria for a priority habitat[91]. A total of 14 hedgerows were species-rich (in accordance with criteria in the Hedgerow Survey Handbook[92]) and 115 species-poor. Fourteen

[88] Maddock, A. (ed) (2008). *UK Biodiversity Action Plan Priority Habitat Descriptions – Traditional Orchards*. Online: https://data.jncc.gov.uk/data/2829ce47-1ca5-41e7-bc1a-871c1cc0b3ae/UKBAP-BAPHabitats-56-TraditionalOrchards.pdf
[89] Maddock, A. (ed) (2008). *UK Biodiversity Action Plan Priority Habitat Descriptions – Lowland Mixed Deciduous Woodland*. Online: https://data.jncc.gov.uk/data/2829ce47-1ca5-41e7-bc1a-871c1cc0b3ae/UKBAP-BAPHabitats-30-LowlandMixedDecWood.pdf
[90] Maddock, A. (ed) (2008). UK BAP Priority Habitat Descriptions - Lowland Meadows. Online: https://data.jncc.gov.uk/data/f0553254-1d47-474a-98e5-37fa163a28b5/UKBAP-BAPHabitats-29-Lowland-Meadows.pdf 2
[91] Maddock, A. (ed) (2008). *UK Biodiversity Action Plan Priority Habitat Descriptions – Hedgerows*. Online: https://data.jncc.gov.uk/data/ca179c55-3e9d-4e95-abd9-4edb2347c3b6/UKBAP-BAPHabitats-17-Hedgerows.pdf
[92] DEFRA (2007) Hedgerow Survey Handbook. A standard procedure for local surveys in the UK. DEFRA, London

hedgerows within the survey area are 'Important', as defined by the wildlife and landscape criteria set out in Schedule 1 of The Hedgerows Regulations 1997.

7.6.24. The broadleaved semi-natural woodland, traditional orchards and unimproved neutral grassland have each been ascribed a value of County importance for biodiversity. The traditional orchard habitat at Stanboro Lane was surrounded by a mosaic of other habitats including amenity grassland, species-poor semi-improved grassland, semi-improved neutral grassland and scrub. These habitats immediately surrounding the traditional orchard are also included in the valuation of County importance, as together they combine to function as a complex habitat mosaic of greater value than isolated patches of the individual habitats (referred to as Stanboro Lane orchard habitat complex). Hedgerows have been ascribed a value of Local importance for biodiversity.

7.6.25. LA 108 advises that UK BAP priority habitats and habitats of principal importance should be considered to be of National nature conservation value. The importance levels ascribed to broadleaved semi-natural woodland/lowland mixed deciduous woodland, traditional orchard, unimproved neutral grassland/lowland meadow and hedgerows (discussed in the paragraphs above) therefore deviate from LA 108. Justification for this deviation is provided in the following paragraphs.

7.6.26. Considering lowland mixed deciduous woodland and traditional orchard, the reason for this deviation is that the habitats in question are all small, isolated examples of habitat types that are fairly common in the wider region and are not particularly notable examples of these habitat types. The lowland mixed deciduous woodland and traditional orchards are considered to be of County importance as opposed to Local by virtue of their inclusion on the Section 41 list of habitats of principal importance for conservation of biodiversity in England.

7.6.27. Considering the lowland meadow, both areas of lowland meadow are small and isolated. They do not fulfil the criteria described in the SSSI lowland grassland selection guidelines[93] or the Gloucestershire Local Wildlife Site selection guidelines[94]. One area (the A4019 verge) fulfils the criteria of the Gloucestershire Conservation Road Verges selection guidelines[95], which is a designation of County value. The remaining area of lowland meadow (the Stanboro Lane verge) does not meet these criteria. Nevertheless, both areas of lowland meadow are ascribed a value of County importance.

7.6.28. Considering the hedgerows, these were predominantly species poor, and only relatively short stretches of hedgerow are present within the Scheme Boundary. Furthermore, although there has been loss of hedgerows and field boundaries in recent decades due to agricultural intensification, hedgerows and hedgerows with trees are frequent throughout Gloucestershire. Nevertheless, the hedgerow network provides ecological connectivity, combining with the strips of woodland, motorway verge habitats and riverside habitats to form a network of habitat corridors through an otherwise ecologically impoverished landscape.

7.6.29. In a number of locations, patches of semi-improved neutral grassland, plantation woodland, scrub and scattered trees were present adjacent to one another. Small areas of other, lower value habitat types, including amenity grassland, tall ruderal, poor semi-improved grassland, buildings, bare ground, hardstanding and private gardens, were often present as well. Together, they form complex habitat mosaics, with the small areas of lower value habitat types combining to function as an area of greater value than the isolated patches of the individual habitats. These habitat complexes are described below and are all considered to be of Local importance.

- A4019 habitat complex – A mosaic of habitats was present located partially within the Scheme Boundary to the north of the A4019, east of Uckington at a derelict

[93] Jefferson, R.G., Smith, S.L.N. & MacKintosh, E.J. 2019. Guidelines for the Selection of Biological SSSIs. Part 2: Detailed Guidelines for Habitats and Species Groups. Chapter 3 Lowland Grasslands. Joint Nature Conservation Committee, Peterborough.
[94] Gloucestershire Centre for Environmental Records (July 2015) Gloucestershire Key Wildlife Sites Handbook. Online: https://www.gloucestershirewildlifetrust.co.uk/wildlife/local-wildlife-sites
[95] GCC/GWT/GCER v2.4. 2022. Available from: https://www.gloucestershire.gov.uk/media/6565/crv-register-v2_4-2022.pdf

horticultural nursery. This area comprised unmanaged semi-improved neutral grassland, coniferous plantation woodland, young fruit trees, ephemeral/ short perennial, bracken, amenity grassland, tall ruderal, and scrub, interspersed with various types of temporary and permanent structure, hardstanding and debris.

- Moat Lane habitat complex – An area of standing water, scattered trees, woodland, mature residential gardens and semi-improved neutral grassland was located immediately south of Moat Lane, to the south of the A4019, approximately 80 m south of the Scheme Boundary.
- M5 Junction 10 and motorway embankments habitat complex – The dominant habitat types within and immediately surrounding the junction included broadleaved and mixed plantation woodland. Woodland extended along the motorway verges, interspersed with areas of scrub and semi-improved neutral grassland. The woodland extended beyond the embankments in some locations, particularly to the south of the junction, on the east side of the motorway to the north and south of the River Chelt, and just south of the Withybridge Gardens properties. This habitat complex also includes the broadleaved plantation woodland between the A4019 and Stanboro Lane, the semi-improved neutral grassland and mixed plantation woodland north of Stanboro Lane and the mature residential gardens along Withybridge Gardens. This habitat complex is located almost entirely within the Scheme Boundary.
- B4634 habitat complex – An area of scattered trees, amenity grassland, semi-improved neutral grassland and mature residential gardens was present immediately south of the B4634, to the west of the Link Road, adjacent to the Scheme Boundary.

7.6.30. Areas of arable habitat and improved grassland are ascribed a value of less than local importance given their species-poor and homogeneous nature. Similarly, small, isolated areas of scattered trees, semi-improved neutral grassland, amenity grassland, poor semi-improved grassland, buildings, bare ground, hardstanding, ephemeral/short perennial and private gardens, where they are located outside of the habitat complexes described above, are ascribed a value of less than local importance for biodiversity.

Bats

7.6.31. The desk study indicated that there are three EPS licences granted for bats within 2 km of the Scheme Boundary:

- 2015-8404-EPS-MIT is a licence granted approximately 170 m east of the M5. The licence is in effect until 2025 and allows for the destruction of a resting place of brown long-eared and lesser horseshoe bats.
- 2017-28135-EPS-MIT is a licence granted approximately 500 m west of the M5. The licence was in effect until March 2022 and allowed for the destruction of a resting place for common pipistrelle, lesser horseshoe and soprano pipistrelle.
- 2019-41747-EPS-MIT is a licence granted approximately 1.45 km east of the Scheme Boundary within Cheltenham town. The licence was in effect until October 2022 for the destruction of common pipistrelle, soprano pipistrelle and brown long-eared bat roosts.

7.6.32. GCER provided 29 records of bat species that have been recorded within the desk study area. These comprised records of:

- Bechstein's bat.
- Brown long-eared bat.
- Common pipistrelle bat.
- Soprano pipistrelle bat.
- Pipistrelle species.
- Daubenton's bat.

- Lesser horseshoe bat.
- Noctule bat.

7.6.33. The bat surveys originally included surveys of trees and structures which are no longer within the final EZoI. The following species and roosts were recorded, and they are included here for context:

- Bechstein's bat – one day roost.
- Common pipistrelle bat – one day roost.
- Pipistrelle species – one possible day roost.
- Myotis species – one possible day roost and one unknown roost type (likely individual bats).
- Natterer's bat –one unknown roost type (likely individual bats).
- Lesser horseshoe bat – two unknown roosts (likely individual bats).
- Unidentified bat species – one day roost.

7.6.34. Table 7-6 below details the bat survey results of the structures and trees within the survey area.

Table 7-6 - Total number of structures and trees and their bat roost suitability

	Total Nnumber Iidentified	Confirmed	High	Moderate	Low	Negligible	No sSurvey Ccompleted to Ddate
Structures	329	51 (including 1 former roost)	12	26	64	70	106
Individual trees	353	7	18	51	116	149	12
Tree groups	105	0	0	0	28	77	N/A

7.6.35. The majority of the bat roosts were used by 'common' bat species (i.e. brown long-eared, common pipistrelle and soprano pipistrelle) based on Wray *et al*., (2010)[96]. There were also 'rarer' bats (based on Wray *et al*.) including two whiskered bat roosts (one in the northern quadrant and one in Butler's Court within the southern quadrant), ten Natterer's roosts (two trees in the southern quadrant, seven structures within Butler's Court in the southern quadrant, one structure in the eastern quadrant[97]), five noctule roosts (two tree roosts in the western quadrant, two tree roosts in the southern quadrant and one structure in the eastern quadrant), and ten lesser horseshoe bat roosts (three in Butler's Court within the southern quadrant, and the remaining seven were all located to the east of the study area, five in the eastern quadrant and two in the southern quadrant). One 'rarest' species (based on Wray *et al*.) roost was also recorded, a barbastelle tree roost in the northern quadrant.

7.6.36. The majority of the roosts were day, night, transitional, mating and feeding roosts, however there was one Natterer's maternity roost in the southern quadrant, one brown long-eared hibernation roost within the southern quadrant, three pipistrelle (common or soprano) maternity roosts in the southern quadrant and one common pipistrelle hibernation roost in the eastern quadrant.

[96] Wray et al., Valuing Bats in Ecological Impact Assessment (CIEEM (2010) In Practice Number 70)
[97] This is a confirmed *Myotis* species record, and Natterer's is the assumed species based on the call characteristics as no DNA survey has been possible.

7.6.37. For unsurveyed and partially surveyed structures it has been necessary to predict the bat roosts present, using existing survey data and taking a reasonably precautionary approach. Further information about the approach taken is detailed within Appendix F of Technical Appendix 7.3 – Bat Surveys (Aapplication document TR010063/—APP-/6.15). As explained in paragraph 7.4.38, the emerging 2023 survey work is confirming that a precautionary approach has been taken, and the predicted roosts presented here are likely to be an over-estimation. Thirty-nine additional bat roosts are predicted to be potentially present within structures within the survey area, on a reasonably precautionary basis. These have been split into roosts of lesser horseshoe bats, other void dwelling bats and crevice dwelling bats, and then further categorised by rarity (rarest, rarer or common) based on Wray *et al*., (2010)[98]), as follows:

- Six lesser horseshoe bat roosts – one potential maternity roost and five roosts supporting small numbers of bats.
- Six bat roosts of void dwelling species (including potentially Barbastelle, Natterer's, serotine, Daubenton's or brown long-eared bat, excluding lesser horseshoe bats) comprising:
    - Barbastelle (rarest) – one roost supporting small numbers of bats.
    - Natterer's/serotine/Daubenton's (rarer) – one potential maternity roost and one roost supporting small numbers of bats.
    - Brown long-eared (common) – three roosts supporting small numbers of bats.
- Twenty bat roosts of crevice dwelling species (including potentially Barbastelle, Nathusius' pipistrelle, Natterer's, Daubenton's, whiskered, Leisler's, noctule, serotine, common pipistrelle or soprano pipistrelle) comprising:
    - Barbastelle (rarest) – one roost supporting small numbers of bats.
    - Nathusius' pipistrelle/Natterer's/Daubenton's/whiskered/ Leisler's/noctule/serotine (rarer) – one potential maternity roost and six roosts supporting small numbers of bats.
    - Common pipistrelle/soprano pipistrelle (common) – two potential maternity roosts and ten roosts supporting small numbers of bats.
- Seven hibernation roosts, comprising:
    - Barbastelle (rarest) – one hibernation roost supporting a solitary bat.
    - Lesser horseshoe/Natterer's/serotine/Nathusius' pipistrelle/ Leisler's/Daubenton's/whiskered/Brandt's/noctule (rarer) – one hibernation roost supporting larger numbers of bats and one hibernation roost supporting a solitary bat.
    - Common pipistrelle/soprano pipistrelle/brown long-eared (common) – one hibernation roost supporting larger numbers of bats and three hibernation roosts supporting a solitary bat.

7.6.38. Of all the trees surveyed (344 individual trees have had full/partial surveys and 105 tree groups were surveyed in full) only 2% of trees had a confirmed bat roost within them. However, as tree roosts are frequently unoccupied (leading to risk of underestimating the roost resource) it has therefore been assumed on a precautionary basis that all unsurveyed/partially surveyed trees support a bat roost. This includes 11 partially surveyed trees that would be felled, and 23 unsurveyed/partially surveyed trees predicted to experience temporary disturbance as a result of the Scheme. As explained in paragraph 7.4.38, the emerging 2023 survey work is confirming that a precautionary approach has been taken, and the predicted roosts and impacts presented here are likely to be an over-estimation.

7.6.39. Based on bat species known in the vicinity, that are known to roost within trees99, the following species could potentially be present within the tree roosts: Common pipistrelle, soprano pipistrelle, Nathusius pipistrelle, Bechstein's, Natterer's, Daubenton's,

[98] Wray et al., Valuing Bats in Ecological Impact Assessment (CIEEM (2010) In Practice Number 70)
[99] Bat Roosts in Trees: A Guide to Identification and Assessment for Tree Care and Ecology Professionals

whiskered, Brandt's, Leisler's, noctule and barbastelle. Consideration has been given to the proportion and type of roost of each species, taking into account the known species assemblage and species abundance within the survey area, as follows:

- Barbastelle/Bechstein's (rarest) – three roosts supporting small numbers of bats.
- Natterer's/Daubenton's/whiskered/Brandt's/Nathusius' pipistrelle/Leisler's/noctule (rarer) – five potential maternity roosts and five roosts supporting small numbers of bats.
- Common pipistrelle/soprano pipistrelle (common) – 11 potential maternity roosts and ten roosts supporting small numbers of bats.

7.6.40. At least thirteen species of bat have been recorded throughout the study area; common pipistrelle, soprano pipistrelle, Nathusius' pipistrelle, *Myotis* (Natterer's and whiskered confirmed by DNA and Daubenton's confirmed by ALBST), noctule, Leisler's, brown long-eared bat, lesser horseshoe bat, greater horseshoe bat, serotine and barbastelle. This is considered to be a wide range of bat species, which is expected given the size of the survey area and the range of habitats present, albeit the dominant habitat type is agricultural grassland. Given the location of the Scheme within the southwest of England, which is within the ranges of Annex II bat species (lesser horseshoe, greater horseshoe, Bechstein's and barbastelle), the presence of these species is expected. However, given that the habitats are sub-optimal for Annex II bats, comprising predominantly agricultural habitats with small blocks of orchards and woodland and relatively limited connecting habitats, it is expected to have only limited usage by Annex II bat species. This is reflected in the low Bat Activity Index (BAI) for greater horseshoe (1.3 passes per night) and barbastelle (6.5 passes per night) across the entirety of the survey area. Lesser horseshoe bats had a higher BAI of 26.3 passes per night, although this is still considerably lower than the BAI for common pipistrelle (BAI of 3,096.6 passes per night) and soprano pipistrelle (BAI of 743.5 passes per night). Pipistrelle species (excluding Nathusius' pipistrelle), *Myotis* species and Nyctaloid were the most abundant species recorded, account for 98.9% of all passes, which is as expected given the agricultural habitats present. It is not possible to differentiate Bechstein's bats from other *Myotis* bat species due to them having similar call structures; therefore, abundance of Bechstein's bats has been interpreted from the results of the roost surveys and ALBST, as well as an assessment of the habitats present.

7.6.41. Bat activity was highest in the following areas (as shown in Figures 7-3 I to W, in Technical Appendix 7.3 – Bat Survey (Aapplication document TR010063/—APP/-6.15):

- River Chelt (both sides of the M5 motorway, southern and western quadrants).
- Along Stanboro Lane (within an area comprising farm buildings, pockets of woodland and hedgerow bordered pasture fields in the northern quadrant).
- Moat Lane (where a large waterbody is present, in the southern quadrant).
- Along the Leigh Brook and the hedgerow that extends south of the Leigh Brook to the east of Uckington, north of the A4019 (eastern quadrant) and hedgerow 86, south of the A4109 (southern quadrant).
- The woodland and scrub south of Junction 10, extending parallel to the M5 to the River Chelt, particularly the woodland on the eastern side, south of Withybridge Gardens (southern and western quadrants).
- Close to where the Link Road meets the B4634 (Hayden Hill Fruit Farm) in the southern quadrant.

7.6.42. Additional commuting and foraging locations were also identified within the study area through ALBST:

- Hedgerow 76 in the northern quadrant, hedgerow 35 within the eastern quadrant, and hedgerow 132 in the southern quadrant.
- The tree-lined access track that leads to Butler's Court (southern quadrant).

- Between Hedgerow 155 and 159 (southern quadrant).
- The small orchard along Withybridge Lane (southern quadrant).

7.6.43. Bats were observed to cross the A4019 at an unknown location, before using the hedgerow with trees lining Boddington Lane to access the River Chelt. Bats were shown to be crossing under the M5 motorway via the River Chelt culvert which passes beneath the carriageway. Bats were also observed crossing over the M5 motorway itself (at risk of collision from vehicles). Bats crossed over the A4019 via location Crossing Point 8 (CP8), CP9 (in this approximate location, although the exact location is unknown) and also underneath the A4019 bridge over the M5 (recorded on paired static detectors). These locations are shown in Figure 7-3N in Technical Appendix 7.3 – Bat Survey [A(application document TR010063/—APP/6.15]).

7.6.44. Taking into account the assemblage of species recorded foraging and commuting within the survey area, which includes Annex II species, and considering that the survey area incorporates the River Chelt, which is a key commuting and foraging resource within the landscape, particularly given that good connecting habitat is relatively limited, the bat foraging and commuting habitats have been ascribed a value of Regional importance for biodiversity.

7.6.45. Taking into account the known and predicted assemblage of species recorded roosting within the survey area, which includes Annex II species, the bat roost resource has been ascribed a value of Regional importance for biodiversity.

Dormouse

7.6.46. GCER provided one record of a dormouse nest within the study area. The nest was found in a nest tube in a hedgerow to the northwest of Gallagher Retail Park, located approximately 150 m north of the Scheme Boundary (and within Atkins survey area 9, which is described below). Another dormouse nest record was identified through review of a report for the North West Cheltenham Development Area (Elms Park) development. This record is from approximately 415 m north of the Scheme Boundary, and 800 m east of the GCER record (and connected to Atkins survey area 9). Figure 7-4A in Technical Appendix 7.4 – Dormouse Survey (applicationApplication document TR010063—/-APP/6.15) shows the locations of the desk study records and the survey areas.

7.6.47. Suitable habitat for dormouse was observed during the walkover survey, including woodland and hedgerows. However, the overall habitat was considered to be suboptimal for dormouse populations, with the majority of the hedgerows being species-poor and well managed, and the areas of woodland predominantly comprising trees of a similar age without a well-developed understorey.

7.6.48. During the dormouse surveys carried out using nest tubes in 2019 (survey areas 1, 2, 3, 4, 5, 6 and 7), no evidence of dormouse was identified. Similarly, during the footprint tunnel surveys undertaken within the same broad areas in 2022, no evidence of dormouse was identified.

7.6.49. During the dormouse surveys carried out using nest tubes along the A4019 corridor (within survey areas 8 and 9, south and north of the A4019 respectively) in 2021, a suspected dormouse summer nest was found in a nest tube within a hedgerow located parallel to the A4019 on the northern side of the road within survey area 9. Survey area 9 extends to the east of Uckington up to the Gallagher Retail Park and to the west of Uckington opposite Withybridge Lane on the northern side of the A4019. Survey area 4 covers the area between Withybridge Lane and the M5 on the northern side of the A4019. Given that there is some connectivity between survey area 4 and survey area 9, dormice are considered to be present within suitable habitat north of the A4019 and east of the M5.

7.6.50. No evidence of dormouse was recorded in survey area 8, on the southern side of the A4019. Based on the survey data and absence of desk study records, dormouse are likely absent on the south side of the A4019. Hazel dormouse have been known to cross roads

and other open areas[100], and roads less than 12 m wide are generally not considered barriers to dormouse movements[101]. However, the A4019 is a busy road varying in width between approximately 30 m and 10 m. Due to its heavy traffic flow and its overall width, it would likely act as a barrier to dormouse dispersal. At the eastern part of the A4019 within the Scheme Boundary, on the southern side of the road, habitats are unsuitable ~~for dormouse~~for dormouse, comprising industrial units and residential properties and gardens on the outskirts of the western edge of Cheltenham.

7.6.51. Based on the survey data and absence of desk study records, dormouse is likely absent from the study area to the west of the M5. Although present to the east of the M5, north of the A4019, the motorway would act as a barrier to dormouse dispersal.

7.6.52. As no dormice were found during the surveys undertaken in May 2021 to estimate the size of the hazel dormouse population in line with Standing Advice[102], reference has been made to the population densities discussed in The Dormouse Conservation Handbook[103]. Dormice live at low densities. In early summer (before breeding) there are typically only three to five (but sometimes up to ten) adults per hectare in deciduous and conifer habitats. The National Dormouse Monitoring Programme (NDMP) suggests an average of between 1.75 and 2.5 adults per hectare pre-breeding (cited in The Dormouse Conservation Handbook, 2006) and across the country, including sub-optimal habitats, the average population density is approximately 2.2 adults per hectare[103]. Taking into account the largely sub-optimal habitats present, a value of 2.2 adults per hectare is considered an appropriate density for the Scheme.

7.6.53. Assuming that dormice are present north of the A4019 and east of the M5, there is approximately 1.84 ha of suitable dormouse habitat within this area. This gives a total number of four (4.05) adult dormice present within this area[104].

7.6.54. The dormouse receives the highest level of protection as an EPS. It is also a Species of Principal Importance for the Conservation of Biodiversity in England, as listed in accordance with Section 41 of the NERC Act 2006 (hereafter referred to as a SPI), and is identified as a priority species in the Gloucestershire Local BAP[18]. The hazel dormouse is categorised as rare and vulnerable to extinction in the UK[105]. The State of Britain's Dormice report in 2019[106] highlighted that nationally the population has fallen by a half (51%) since 2000, decreasing on average by 3.8% per year.

7.6.55. Given the high level of protection afforded to dormice, their rarity and declining status, as well as consideration of the limited distribution of dormouse within the Scheme, and that the species may be present in an area previously thought not to be occupied by dormouse[107], the population within the dormouse survey area has been ascribed a value of County importance for biodiversity.

Badger

7.6.56. GCER provided three recent records of badger within the study area.

[100] Chanin, P. (2012). Why didn't the dormice cross the gaps? The Dormouse Monitor, 1: 4-5.
[101] Chanin, P. & Gubert, L. (2012). Common dormouse (*Muscardinus avellanarius*) movements in a landscape fragmented by roads. Lutra, 55(1): 3-15.
[102] The process of estimating population density is provided at https://www.gov.uk/guidance/hazel-or-common-dormice-surveys-and-mitigation-for-development-projects.
[103] Bright, P. W., Morris, P. A. & Mitchell-Jones, A. J. (2006). The Dormouse Conservation Handbook (2nd Edition). English Nature, Peterborough.
[104] Based on population densities cited in the Dormouse Conservation Handbook (Bright, P.W., Morris, P.A. & Mitchell-Jones, A.J. (2006). *The Dormouse Conservation Handbook* (2nd Edition). English Nature, Peterborough).
[105] Dormouse Status and Conservation, People's Trust for Endangered Species url: https://ptes.org/get-informed/facts-figures/hazel-common-dormouse-muscardinus-avellanarius/ [Accessed October 2022].
[106] Wembridge, D., Al-Fulaij, N. & Langdon, S. (2019). The State of Britain's Dormice 2019. People's Trust for Endangered Species.
[107] A report produced for a separate planning application (the North West Cheltenham Development Area, north of the A4019, planning application 16/02000/OUT) states 'Anecdotally dormice had not been recorded locally in recent history and this had also been confirmed by Gloucestershire Wildlife Trust who generally considered the species to be absent from this area of the Severn Valley' (Persimmon Homes/Bloor Homes (October 2017) Framework Dormouse and Reptile Mitigation Strategy).

7.6.57. The field surveys identified that the habitats within the study area are suitable for badger foraging and sett creation. Thirty badger setts were found during the targeted badger surveys, and incidentally during other surveys. Eleven of these are located within 50 m of the Scheme Boundary. This includes three main setts, two annexe setts, two subsidiary setts (one of which was disused), two outlier setts (one of which was disused) and two subsidiary setts with the capacity to become main setts.

7.6.58. Badgers are common and widespread within Gloucestershire and are not considered to be a species of nature conservation concern. Badger has therefore been ascribed a value of less than Local importance for biodiversity. However, appropriate mitigation is included in Section 7.7 where necessary to ensure legal compliance.

Otter

7.6.59. GCER provided two records of otter within the study area. These were both on the River Chelt; one of an adult otter seen swimming upstream between the M5 and Withybridge Lane, and one record of otter prints recorded west of the M5 between Boddington and the A4019.

7.6.60. 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.

7.6.61. The surveys have confirmed otter presence on the River Chelt and minor watercourse MW5. Three otter resting site features along the River Chelt and one resting site feature on MW5 have been assigned low value, indicating that the features are not suitable as a breeding/natal site, and are unlikely to afford sufficient seclusion to be an important resting site. They are more likely to provide a temporary 'stop off' for otters when moving throughout their territory. Potential breeding behaviour was observed between two adult otters during the otter monitoring surveys along the River Chelt.

7.6.62. In addition, the potential for otters to be present has been highlighted at several suitable habitat features (Leigh Brook, minor watercourse MW4, Pond 22, Pond 23 and Pond 24) due to the habitat connectivity between these features and other suitable habitat. Otters have large home ranges and may use different habitats throughout the year. Therefore, it is considered appropriate to consider these additional habitat features in this assessment despite a lack of positive evidence recorded during the presence / likely absence surveys.

7.6.63. Suitable otter habitat has been recorded throughout the study area, and usage of this habitat has either been confirmed or is considered possible. It is considered likely that these habitats comprise the home range of a small number of individual otters with the potential for territory overlap, and the River Chelt and Leigh Brook provide connectivity to the wider landscape. Therefore, this area is likely to be of importance in maintaining the distribution of the species within Gloucestershire. Otter receives the highest level of protection as an EPS. It is also a SPI and is identified as a priority species in the Gloucestershire Local BAP[18]. Otter has therefore been ascribed a value of County importance for biodiversity.

Water vole

7.6.64. GCER provided no records of water vole from within the study area.

7.6.65. Suitable habitat for water vole was identified during the habitat suitability assessment surveys undertaken in 2019 and 2021 along the River Chelt and connecting minor watercourses. Subsequently, two presence / likely absence surveys were 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.

7.6.66. No impacts to water vole are anticipated as a result of the Scheme, and water voles are therefore not considered further within this report.

Other priority mammals

7.6.67. GCER provided records of two other priority mammal species, hedgehog and polecat.

7.6.68. Two records of polecat were provided, one from within the Scheme Boundary which was a road casualty along the A4019 from 2020. The other record was from approximately 800 m north east from within a residential garden in 2021. Polecat have also been observed within the study area incidentally during the ongoing surveys, which included another road casualty identified near Hayden.

7.6.69. Numerous records of hedgehog were provided from many locations across the study area.

7.6.70. Two other priority mammals have been observed within the study area during ongoing surveys:

- Brown hare – recorded on the Boddington Estate.
- Harvest mouse – nest found underneath reptile refugia.

7.6.71. Suitable habitats for these species have been observed throughout the study area.

7.6.72. No further surveys for priority mammal species are considered necessary, as the assessment has been based on the assumption that hedgehog, brown hare, polecat and harvest mouse occur intermittently in suitable habitats throughout the study area and that these are the only other priority mammal species present. In accordance with this assumption, other priority mammals have been ascribed a value of Local importance for biodiversity.

Breeding and wintering birds (excluding barn owl)

7.6.73. GCER provided details of 40 priority bird species which have been recorded within the study area, of which 30 species were recorded within the wintering season (i.e. September to March inclusive) and 32 were recorded within the breeding season (i.e. March to August inclusive).

7.6.74. The Gloucestershire Local BAP includes action plans for 13 bird species in total, which comprise bittern, nightjar, woodlark, spotted flycatcher and 'farmland birds' (skylark, linnet, reed bunting, corn bunting, tree sparrow, grey partridge, bullfinch, turtle dove and song thrush).

Wintering birds

7.6.75. During the field surveys, a total of 64 species were recorded within the study area, of which 27 are priority species. This includes:

- Five species listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) (barn owl, fieldfare, kingfisher, red kite and redwing).
- Twelve species on the Red List[108] (house martin, fieldfare, herring gull, house sparrow, lapwing, linnet, mistle thrush, redwing, skylark, spotted flycatcher, starling and yellowhammer) and 12 species on the Amber List[108] (black-headed gull, dunnock, kestrel, lesser black-backed gull, mallard, meadow pipit, redstart, reed bunting, stock dove, grey wagtail, song thrush and willow warbler).
- Ten species listed as SPI (dunnock, herring gull, house sparrow, linnet, reed bunting, skylark, song thrush, starling, spotted flycatcher and yellowhammer).

[108] Stanbury, A., Eaton, M., Aebischer, N., Balmer, D., Brown, A., Douse, A., Lindley, P., McCulloch, N., Noble, D., and Win I. (2021). The status of our bird populations: the fifth Birds of Conservation Concern in the United Kingdom, Channel Islands and Isle of Man and second IUCN Red List assessment of extinction risk for Great Britain. British Birds 114: 723-747.

- Three species listed on Annex 1 of the Birds Directive (merlin, peregrine and red kite).
- Five species listed on the Gloucestershire Local BAP (linnet, reed bunting, skylark, song thrush and spotted flycatcher)[109].
- Two qualifying species of the Severn Estuary SPA (lapwing and mallard).
- Two species identified on the Severn Estuary Ramsar Information Sheet (herring gull, identified as noteworthy fauna and lesser-back backed gull, identified as a species subsequent to designation for possible future consideration under criterion 6).

7.6.76. Three additional species were recorded during other ecology surveys undertaken during the winter and passage period (September to March inclusive) that were not observed during the wintering and passage bird surveys: little owl (no legal/conservation status), snipe and tawny owl (both on the Amber List[108]).

7.6.77. The assemblage of wintering and passage birds is considered to be largely typical of agricultural areas, woodland and scrub and built-up areas within Gloucestershire.

7.6.78. Sixty of the 64 species recorded during the wintering and passage bird survey or as an incidental observation have a Gloucestershire resident, wintering or passage population status that is abundant, common or fairly common[110].

7.6.79. Seven species recorded during the wintering and passage bird survey or as an incidental observation have a Gloucestershire resident, wintering or passage population status that is uncommon or scarce[110]. These comprise barn owl, chiffchaff, kingfisher, lesser whitethroat, raven, red kite and stonechat.

7.6.80. Two qualifying species of the Severn Estuary SPA have been recorded: Lapwing (two individuals) and mallard (peak count of nine individuals). Given the low numbers recorded they are unlikely to be a significant component of the SPA populations. This is supported by a recent study[111] which identifies functionally linked land associated with the Severn Estuary SPA. The maps which accompany this study do not indicate that these species regularly move between the SPA and the study area for the Scheme.

7.6.81. However, the study also indicates that lapwing have been recorded within the survey area (in the vicinity of Boddington Manor Farm, at the west of the Scheme) in numbers which reached or exceeded the equivalent of the 1% SPA population criterion for importance on at least one occasion. No lapwing were recorded at this location during the wintering and passage bird surveys, and as the study indicates that there are no regular movements between the SPA and this location, it is therefore considered that this area is not regularly used by or of particular importance for lapwing.

7.6.82. Two species identified on the Severn Estuary Ramsar Information Sheet have been recorded. Herring gull (identified as noteworthy fauna occurring at levels of national importance during the breeding season) was recorded in relatively high numbers on two occasions (September and December 2019, with a peak count of 306). Lesser black-backed gull (identified as a species subsequent to designation for possible future consideration under criterion 6) was recorded in relatively high numbers on one occasion (a peak count of 148 in September 2019). It is considered that these individuals are likely to be from breeding populations within urban areas such as Cheltenham and/or Gloucester, which are closer to the Scheme than the Ramsar Site breeding colonies at Steep Holm and Flat Holm[112] (approximately 90 km south west). Cheltenham Borough Council states that “Herring Gulls and Lesser Black-Backed Gulls nest in the residential

[109] Gloucestershire Biodiversity Partnership (2000) Biodiversity Action Plan for Gloucestershire. Online: https://www.gloucestershirenature.org.uk/biodiversity-action-plan-bap
[110] Goodhall, R., Kirk, G. and Petrek, S. (2020) Gloucestershire Bird Report 2014-16. Gloucestershire Ornithological Co-ordinating Committee
[111] Link Ecology Ltd (September 2020) Identification of land with proven or possible functional linkages with the Severn Estuary SSSI/SPA Phase 5 (Gloucestershire and Worcestershire) A report to Natural England.
[112] Burton, N.H.K., Musgrove, A.J., Rehfisch, M.M., and Clark N.A. (2010) Birds of the Severn Estuary and Bristol Channel: Their current status and key environmental issues. Marine Pollution Bulletin 61 (2010) 115–123

areas of Cheltenham and on industrial units in the Kingsditch area"[113]. The JNCC Seabird Monitoring Programme online database states that the Gloucestershire Urban Gulls Cheltenham site (85627) supported 46 herring gull apparently occupied territories and 273 lesser black-backed gull apparently occupied territories in 2011 (year of last count) and the Gloucester City: Gloucester site (86737) supported 657 herring gull apparently occupied nests and 2230 lesser black-backed gull apparently occupied nests in 2009 (year of last count)[114]. It follows that the lesser black-backed gulls recorded are unlikely to be part of the Ramsar Site population.

7.6.83. The habitats within the survey area are not considered to provide a role in maintaining the SPA or Ramsar Site populations or be functionally linked to any SPAs or Ramsar Sites.

7.6.84. Although five species are listed on the Gloucestershire Local Biodiversity Action Plan, these species are currently listed as either common, formerly common or fairly common within Gloucestershire. The peak counts for these species within the study area are not considered to be of county importance in relation to Gloucestershire populations.

7.6.85. Therefore, taken as a whole, the wintering and passage bird assemblage is considered to appreciably enrich the habitat resource within the local context, which includes features of importance for migration. The assemblage of these wintering and passage birds is therefore considered to be of Local importance for biodiversity.

Breeding birds

7.6.86. During the field surveys, a total of 62 species were recorded within the study area, of which 26 are priority species. This includes:

- Three species are listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) (hobby, kingfisher and red kite).
- Ten species on the Red List (house martin, swift, herring gull, house sparrow, linnet, mistle thrush, skylark, starling, yellow wagtail and yellowhammer) and 13 species on the Amber List[108] (grey wagtail, song thrush, black-headed gull, bullfinch, dunnock , kestrel, kingfisher, lesser black-backed gull, mallard, meadow pipit, reed bunting, stock dove, and willow warbler).
- Eleven species listed as SPI (bullfinch, dunnock, herring gull, house sparrow, linnet, reed bunting, skylark, song thrush, starling, yellow wagtail and yellowhammer).
- Three species listed on Annex 1 of the Birds Directive (kingfisher, little egret and red kite).
- Five species listed on the Gloucestershire Local Biodiversity Action Plan (bullfinch, linnet, reed bunting, skylark and song thrush).
- One qualifying feature of the Severn Estuary SPA (mallard).
- Three species identified on the Severn Estuary Ramsar Information Sheet have been recorded. Herring gull and little egret are identified as noteworthy fauna and lesser-black backed gull is identified as a species subsequent to designation for possible future consideration under criterion 6.

7.6.87. Of the 62 species recorded, 33 species are confirmed as breeding or considered to have bred, 15 species are probable breeders, and 10 species are possible breeders within the study area.

7.6.88. Two additional species were recorded during other ecology surveys undertaken during the breeding period (March to August inclusive) that were not observed during the breeding bird surveys: barn owl and tawny owl. Barn owls are discussed separately in the following section. Tawny owl was seen on one occasion in suitable breeding habitat and is considered to be possibly breeding.

[113] Cheltenham Borough Council (2018) Urban Gulls Scrutiny Task Group Report. Available at https://democracy.cheltenham.gov.uk/documents/s27390/2018_12_04_CAB_Urban_Gulls_scrutiny_report.pdf
[114] Available at https://app.bto.org/seabirds/public/index.jsp

7.6.89. The assemblage of breeding birds is considered to be largely typical of agricultural areas, woodland and scrub and built-up areas within Gloucestershire.

7.6.90. Five species are identified in a county or equivalent authority area plan or strategy, i.e. within the Gloucestershire Local BAP (under 'farmland birds'): bullfinch (peak count of two), linnet (peak count of seven), reed bunting (peak count of one), skylark (peak count of 31) and song thrush (peak count of 15).

7.6.91. Fifty-six of the 62 species recorded during the breeding bird survey or as an incidental observation have a Gloucestershire breeding population status that is abundant, common or fairly common[110].

7.6.92. Seven species recorded during the breeding bird survey or as an incidental observation have a Gloucestershire breeding population status that is uncommon or scarce[110]. These comprise barn owl, grey wagtail, herring gull, hobby, lesser whitethroat, red kite and yellow wagtail.

7.6.93. One qualifying species of the Severn Estuary SPA has been recorded, mallard (peak count of ten). Given the low numbers of mallard recorded, they are unlikely to be a significant component of the SPA populations. This is supported by a recent study[111] which identifies functionally linked land associated with the Severn Estuary SPA. The maps which accompany that study do not identify that these species regularly move between the SPA and the study area.

7.6.94. Three features identified on the Severn Estuary Ramsar Information Sheet have been recorded. Herring gull and little egret (identified as noteworthy fauna) and lesser black-backed gull (identified as a species for possible future consideration under criterion 6) were generally recorded in low numbers (peak counts of 18, 4 and 57 respectively). It is considered that the gull species recorded are likely to be breeding within urban areas such as Cheltenham and/or Gloucester, as opposed to the Ramsar Site breeding colonies at Steep Holm and Flat Holm[115] (located approximately 90 km south west). Cheltenham Borough Council states that "Herring Gulls and Lesser Black-Backed Gulls nest in the residential areas of Cheltenham and on industrial units in the Kingsditch area"[116]. The JNCC Seabird Monitoring Programme online database states that the Gloucestershire Urban Gulls Cheltenham site (85627) supported 46 herring gull apparently occupied territories and 273 lesser black-backed gull apparently occupied territories in 2011 (year of last count) and the Gloucester City: Gloucester site (86737) supported 657 herring gull apparently occupied nests and 2230 lesser black-backed gull apparently occupied nests in 2009 (year of last count)[117].

7.6.95. The habitats within the survey area are not considered to provide a role in maintaining the SPA or Ramsar Site populations or functionally linked to any SPAs or Ramsar Sites.

7.6.96. Although five species are listed on the Gloucestershire Local BAP, these species are currently listed as either common or fairly common resident breeders within Gloucestershire. The peak counts for these species within the survey area are not considered to be of county importance in relation to breeding numbers for Gloucestershire.

7.6.97. Therefore, taken as a whole, the breeding bird assemblage is considered to appreciably enrich the habitat resource within the local context. The assemblage of breeding birds is therefore considered to be of Local importance for biodiversity.

[115] Burton, N.H.K., Musgrove, A.J., Rehfisch, M.M., and Clark N.A. (2010) Birds of the Severn Estuary and Bristol Channel: Their current status and key environmental issues. Marine Pollution Bulletin 61 (2010) 115–123
[116] Cheltenham Borough Council (2018) Urban Gulls Scrutiny Task Group Report. Available at https://democracy.cheltenham.gov.uk/documents/s27390/2018_12_04_CAB_Urban_Gulls_scrutiny_report.pdf
[117] Available at https://app.bto.org/seabirds/public/index.jsp

Barn owl

7.6.98. GCER provided one record of barn owl from within 1.5 km of the Scheme Boundary, located approximately 1.2 km north east of the Scheme Boundary.

7.6.99. Barn owls were recorded incidentally during other ecology surveys. This species was observed at the same location (along the B4634) on two separate occasions in the same breeding season (June and July 2020) within potentially suitable breeding habitat, and is therefore considered likely to be breeding in the area.

7.6.100. The targeted barn owl surveys recorded patches of potential barn owl foraging habitat (optimal and sub-optimal habitat) throughout the survey area, predominantly located at the east and south of the survey area. Large, continuous areas of optimal and sub-optimal habitats were relatively rare within the survey area, with the vast majority of the survey area occupied by poor foraging habit. Of the total area assessed within the survey area, there was a total of 108 ha of suitable barn owl foraging habitat (14.8% of the area assessed).

7.6.101. No occupied breeding sites were identified with the survey area. A total of 15 PNS (comprising 12 mature/dead trees and three agricultural buildings) and a total of two active roost sites (one barn located just north of the A4019 at Uckington and one tree located between Withybridge Lane and the Link Road) were identified within the survey area. PNS were recorded in the highest number in trees at the south of the survey area. Although 15 PNS were recorded, this is a precautionary assessment due to lack of accessibility, and no actual evidence of barn owl use was recorded, with the exception of the two ARS.

7.6.102. The survey results indicate the current or recent (within the last 12 months) presence of barn owl at three locations within the survey area. This includes the two ARS and one recent incidental record of a barn owl seen flying near Stanboro.

7.6.103. Taking into account the potential foraging habitat available, the ARS and incidental records/sightings, it is considered that the survey area could support up to four barn owl territories (i.e. the survey area forms part of a barn owl's territory, even if the nest site is not physically within the survey area).

7.6.104. Barn owl have a Gloucestershire breeding population status that is uncommon or scarce[110]. However barn owl are widely distributed across the county where there is suitable habitat, with potentially 91 pairs[118] within the county. Assuming 91 pairs, if the survey area supports four barn owl territories, the survey area could represent approximately 4.4% of the county population.

7.6.105. On this basis, and considering the level of protection afforded to barn owl under the Wildlife and Countryside Act 1981 (as amended), in particular their inclusion on Schedule 1, barn owl has been ascribed a value of County importance for biodiversity.

Reptiles

7.6.106. GCER provided records of two reptile species within the study area, two common lizards and two slow worms. The common lizard records are from within the Scheme Boundary.

7.6.107. The walkover surveys identified suitable habitat for grass snake, slow worm and common lizard throughout the study area such as woodland edge, hedgerows, scrub, rough grassland, gardens and embankments.

7.6.108. During the targeted reptile surveys in 2019, 2020 and 2021, no reptiles were recorded within the study area. A grass snake and a common lizard were recorded incidentally during the walkover surveys in 2019, and a juvenile slow worm was recorded during a bird survey in 2019.

[118] Kirk, G. & Phillips, J. (2013). The Birds of Gloucestershire. https://glosnats.org/wp-content/uploads/2022/03/9781846318085.pdf [Accessed: 14/06/22]

7.6.109. Slow-worm, common lizard and grass snake are protected under the Wildlife and Countryside Act 1981 (as amended) from killing and injury. All three species are SPI.

7.6.110. Given the low numbers of reptiles recorded incidentally, it is considered that only low numbers of grass snake, slow worm and common lizard are present within the study area, and reptiles have therefore been ascribed a value of Local importance for biodiversity.

Great crested newt (and other amphibians)

7.6.111. No Natural England great crested newt EPS licences were identified within the study area.

7.6.112. GCER provided three records of great crested newt within the study area (one approximately 150 m south of the Scheme Boundary at Hayden Road Allotments; one from approximately 900 m north west; and one that appears to be close to the Scheme Boundary at its northern extent (but only a four figure grid reference was provided). GCER also provided one record of common toad from Hayden Road Allotments.

7.6.113. A total of 39 waterbodies were identified within 500 m of the Scheme Boundary. Eighteen of these were scoped out as follows, and no HSI assessments were undertaken:

- Four were scoped out as they are located on the opposite side of the River Chelt from the Scheme. The River Chelt is a large, flowing watercourse which is considered to represent a barrier to great crested newt dispersal.
- Nine waterbodies were scoped out as they were completely dry with no aquatic vegetation present.
- One waterbody was scoped out as it was completely saturated in dense algae.
- Although access was not permitted, information gathered through the desk study indicated that four waterbodies are either no longer present, or they are unlikely to be suitable for supporting great crested newts: One appeared to be absent, one was described in another report as being used for manure storage, and two are considered likely to be fishing lakes.

7.6.114. Twenty waterbodies were subject to HSI survey. Five waterbodies were classed as having poor suitability, six as below average suitability, seven as average suitability, one as good suitability, and one as excellent suitability.

7.6.115. Nineteen of these waterbodies were subject to eDNA survey. One waterbody was not considered safe to survey, and it was subsequently scoped out as being unsuitable for great crested newts due to the high levels of visible pollution (human waste) present. Of the 19 waterbodies surveyed, five waterbodies returned positive results for great crested newts, with the remaining returning a negative eDNA result.

7.6.116. Access was not possible at one waterbody, and great crested newts are assumed to be present here, particularly given its proximity to confirmed great crested newt waterbodies.

7.6.117. The waterbodies where great crested newts have been confirmed, or are assumed, can be grouped into two metapopulations[119].

7.6.118. One of these is located approximately 470 m north of the Scheme Boundary, at the edge of the great crested newt study area. Given this distance, the study area is unlikely to be of particular importance to this metapopulation, although small numbers of great crested newts from this metapopulation could be present within the Scheme. The other metapopulation is located approximately 90 m south of the Scheme Boundary, south of the A4019, and the great crested newt study area is likely to be important in maintaining this metapopulation.

[119] Groups of spatially separated waterbodies, generally within 500 m of one another and linked by suitable terrestrial habitat, where presence has been confirmed or assumed and interchange of individual great crested newts is likely or possible.

7.6.119. Great crested newts receive the highest level of protection, being an EPS. Great crested newts are also a SPI, and are identified as a priority species in the Gloucestershire Local BAP[18].

7.6.120. Surveys have shown that great crested newts are widespread throughout the South Midlands, being present in around a third (32%) of ponds in the South Midlands region. Although this varies in places, it is usually higher than the national average (13%)[120].

7.6.121. Despite being widespread in the region, given their high level of protection, this species has been ascribed a value of County importance for biodiversity.

7.6.122. Two common toads (one juvenile and one adult) were recorded during reptile surveys undertaken in September 2019 in the south east part of the Scheme. Common toad is assumed to occur in suitable habitats throughout the study area. Common toad is a SPI. Common toad is considered to appreciably enrich the habitat resource within the local context and has been ascribed a value of Local importance for biodiversity.

Terrestrial invertebrates

7.6.123. GCER provided details of two priority terrestrial invertebrate species recorded within the study area. There was one record of a small heath butterfly from approximately 900 m north of the A4019 corridor, and one record of cinnabar moth from Swindon Farm, which is also located north of the A4019 corridor, north of the Gallagher Retail Park.

7.6.124. 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.

7.6.125. While priority species, such as those listed from the desk study, may occur occasionally, the intensive agricultural habitats which dominate most of the study area are unlikely to support priority assemblages of terrestrial invertebrates.

7.6.126. The two areas of unimproved neutral grassland/lowland meadow habitat could potentially support a more diverse assemblage of invertebrates, including priority species. However, these areas are isolated and very limited in extent (0.1 ha and 0.07 ha), reducing their value to this species group. Nevertheless, these small pockets of more valuable habitat have the potential to enrich the overall assemblage of terrestrial invertebrates.

7.6.127. Traditional orchards at Hayden Hill Fruit Farm, Millhouse Farm and Stanboro Lane could potentially support noble chafer beetle. The Severn and Avon Vales National Character Area[121] is a stronghold for this priority species, which requires decaying wood on fruit trees for the larval stage of its life-cycle.

7.6.128. A precautionary approach has been taken whereby the presence of a key population of noble chafer at Hayden Hill Fruit Farm, Millhouse Farm and Stanboro Lane has been assumed. Given the reliance of the noble chafer on traditional orchard habitat, this species has been valued as part of this habitat and ascribed a value of County importance for biodiversity. The remaining terrestrial invertebrate assemblage has been ascribed a value of less than Local importance for biodiversity.

Protected and priority plants

7.6.129. GCER provided a record of a black poplar tree located over 800 m west of the Scheme Boundary on the Boddington Estate. Black poplar is one of Britain's rarest trees and is identified by GCER as being a Key Gloucestershire Species.

7.6.130. Generally, only common and widespread plant species were observed during the habitat surveys. The intensive agricultural habitats which dominate the study area are unlikely to support priority plant species. Whilst the small areas of semi-improved neutral grassland

[120] Gloucestershire County Council, the great crested newt district licensing scheme document available to download from: https://www.gloucestershire.gov.uk/media/2098673/gcn_district_licence_option_note_gcc.pdf
[121] http://publications.naturalengland.org.uk/publication/1831421?map=true&category=587130 [Accessed 02/09/19].

and unimproved neutral grassland could potentially support priority plant species, the absence of any observations during the habitat surveys (which were undertaken at an optimal time of year for botanical survey), indicates that important populations of such species are likely to be absent. Protected and priority plant species are not considered further within this report.

Invasive non-native plant species

7.6.131. GCER provided no records of invasive non-native plant species (INNS) within the study area.

7.6.132. During the walkover survey, Himalayan balsam was recorded at multiple locations. This species does not have any nature conservation value but is an INNS subject to legal control under the Wildlife and Countryside Act 1981 (as amended) and the Invasive Alien Species (Enforcement and Permitting) Order 2019. This makes it illegal to plant or otherwise cause Himalayan balsam to grow in the wild, and requires management measures to be put in place.

Aquatic habitats and species

7.6.133. A total of 24 watercourses were identified within the study area.

7.6.134. Of these, 14 have been screened in for baseline data collation and further assessment on the basis that they are potentially important biodiversity resources for which Scheme related impact pathways exist. They are the:

- River Chelt (Main River).
- Leigh Brook (Ordinary Watercourse).
- Twelve additional unnamed Ordinary Watercourses (MW3, Drain 8, Drain 9, Drain 10, Drain 11, Drain 12, Drain 14, Drain 15, Drain 16, Drain 20, Drain 21 and Drain 22).

7.6.135. A summary of baseline condition and watercourse evaluation is presented in the following sections. Further details are presented in Technical Appendix 7.12 – Aquatic Ecology Survey (Aapplication document TR010063–/–APP/–6.15), with the location of the watercourses shown in Figure 7-12A.

River Chelt

7.6.136. The River Chelt is a reportable WFD surface waterbody. It is crossed by the existing M5 crossing within Chelt – M5 to confluence River Severn (GB109054032810) waterbody. The waterbody has an Overall Ecological Status of 'Poor', with its biological quality elements classified as 'Poor', with invertebrates at 'Good', and macrophytes at 'Poor'. Fish are not assessed under the WFD at this location.

7.6.137. The proposed new River Chelt bridge crossing and a temporary haul road (Link Road; SO 90743 24593) occur within the Chelt - source to M5 (GB109054032820) waterbody. Here, the River Chelt has an Overall WFD classification of 'Moderate', with biological quality elements at 'Good'.

7.6.138. At the proposed crossing the channel is approximately 3 m wide and has banks up to 5 m high. The incised nature of the channel is indicative of historical management e.g., dredging, and the RHS Habitat Modification Class (HMC) of 5 classifies the reach as 'severely modified'. Despite these modifications, the watercourse has both riffles and pools, resulting in varying depths and a resulting River Condition Assessment class of 'Moderate'. The riparian habitat is uniform and adjacent land use is characterised by arable fields.

7.6.139. The existing M5 crossing on the River Chelt is an embedded box culvert (assumed to be embedded due to the presence of gravel and silt substrates). The riparian habitat is characterised by agricultural land use. Downstream of the M5 the watercourse widens (to approximately 6 m) and exhibits steep banks and a low gradient. A HMC of 5 classifies

the reach as 'severely modified' and the River Condition Assessment determined that this reach is in 'Fairly Poor' condition.

7.6.140. Aquatic macroinvertebrate surveys conducted in 2020 upstream and downstream of both the existing M5 crossing and the proposed bridge crossing showed there to be commonality in the community structure across the sites. The biological metrics did not indicate the presence of a community that was significantly stressed by either poor habitat or water quality. Two notable species were recorded (*Gyrinus urinator* – an aquatic beetle scarce in the UK and a leech species, *Trocheta pseudodina*, which has a restricted distribution in the UK). All other taxa were commonly occurring species. The non-native New Zealand mud snail was recorded at all the survey sites.

7.6.141. A juvenile signal crayfish (an invasive non-native species) was recorded during targeted white-clawed crayfish surveys undertaken on the River Chelt in 2020. Due to the absence of white-clawed crayfish desk study records, the negative result obtained during the field surveys, lack of refuges in the main channel, and taking into account the presence of signal crayfish (which limit the viability of white-clawed crayfish populations), white-clawed crayfish are considered to be absent from the River Chelt and are therefore not considered further within this report.

7.6.142. Aquatic macrophyte surveys undertaken in 2020 at the existing M5 crossing yielded nine scoring taxa[122], all of which are commonly occurring and typical of the lowland watercourse typology. Species occurring at the highest cover value within the channel were water crowfoot and filamentous algae. At the proposed crossing only one species was recorded, branched bur-reed. No invasive macrophyte species were recorded in either survey, although it should be noted that Himalayan balsam occurs frequently along the banks of the River Chelt.

7.6.143. Electric fishing surveys were undertaken at the existing M5 crossing and at the proposed crossing in 2020. Habitat was typified by the presence of extensive glide habitat and areas of shallow riffle habitat were also present. The size of channel and low water depths observed at survey were considered likely to limit salmonid and other major species use of the habitat resource.

7.6.144. At both survey locations minor lithophilic spawners such as minnow and bullhead were present in high numbers. European eel were also recorded at both sites. Two lamprey ammocoetes (larval form) were recorded at the existing M5 crossing. It is not possible to determine if these were brook or river lamprey due to their larval form. As a precaution, they are assumed to be river lamprey for the purpose of the following assessment (as river lamprey are a qualifying feature/interest feature of the Severn Estuary SAC/Ramsar Site).

7.6.145. Review of historical Environment Agency fisheries data has identified that the River Chelt, in addition to the species recorded in 2020, also supports sea/brown trout (recorded from a survey conducted in 2013 from sites 2 km from the Scheme Boundary) and Atlantic salmon (recorded from a site 8 km downstream of the existing M5 River Chelt crossing in 2014). Following consultation with the Environment Agency it has also been confirmed that salmon parr have been recorded during a fish rescue undertaken approximately 5 km downstream of the existing M5 River Chelt crossing prior to a weir removal project. This weir removal is expected to facilitate upstream migration of salmonids and other migratory species in the River Chelt.

7.6.146. European eel is a qualifying feature of the downstream Severn Estuary Ramsar Site, a SPI and critically endangered[123]. River lamprey are a qualifying feature of the Severn Estuary SAC/Ramsar Site and a SPI. Atlantic salmon are a qualifying feature/interest feature of the Severn Estuary Ramsar Site and a SPI. Sea/brown trout are a SPI and sea

[122] Those aquatic taxa which contribute to biological metric calculations. Additional marginal or terrestrial taxa were also recorded, but these are not 'truly aquatic species. See Appendix 7.12 for full species lists.
[123] Jacoby, D. & Gollock, M. (2014). Anguilla anguilla. The IUCN Red List of Threatened Species 2014: e.T60344A45833138. http://dx.doi.org/10.2305/IUCN.UK.2014-1.RLTS.T60344A45833138.en

trout are a qualifying feature of the Severn Estuary Ramsar Site. Bullhead is a European Commission Habitats Directive Annex II species (but not a qualifying feature of the downstream Severn Estuary designations).

7.6.147. Despite being modified throughout much of its length within the study area, the River Chelt supports a species rich aquatic macroinvertebrate assemblage including species that are scarce in the UK and/or have a restricted distribution. The watercourse has also been shown to support a range of typical macrophyte species including water crowfoot.

7.6.148. Based on the range of fish species supported by the watercourse and the presence of otter, the River Chelt meets the criteria for the priority habitat type: rivers[124]. It has been shown to support, or potentially support, qualifying features of the downstream Severn Estuary SAC/Ramsar Site and protected/priority species (including river lamprey (assumed presence), European eel, Atlantic salmon, bullhead and sea/brown trout). The watercourse has therefore been ascribed a value of County importance for biodiversity.

7.6.149. LA 108 advises that UK BAP priority habitats and habitats of principal importance should be considered to be of National nature conservation value. The importance level ascribed to the River Chelt deviates from LA 108. This is because, despite the River Chelt supporting a species rich aquatic macroinvertebrate assemblage, a range of fish species and meeting the criteria for a priority habitat, the watercourse is modified throughout much of its length and supports a species poor aquatic macrophyte assemblage. Furthermore, the Severn Estuary designations are a considerable distance downstream (40 km) from the point of interaction with the Scheme. On this basis, a valuation of County is considered appropriate for the River Chelt resource within the study area.

Leigh Brook

7.6.150. Watercourse habitat surveys have identified the Leigh Brook within the study area as a heavily managed ephemeral feature that exhibits limited habitat complexity and is typically choked with terrestrial herbs and scrub species (indicating only intermittent flow). It is located within a predominantly agricultural setting, with adjacent land use characterised by improved pasture for livestock grazing. There is an extensive tree line at the bank top, composed of scrub and tree species, which acts to shade much of the channel.

7.6.151. The existing M5 culvert (SO 90759 26016), for which there is a proposed culvert extension, was only partially visible during the survey due to the dense growth of tall herbs. No flow was observed at the time of the watercourse walkover survey and only small pools of stagnant water were present. There was evidence of historical channel modifications associated with realignment and over deepening. A limited range of bed substrates (gravel-pebble and silt) were recorded, along with low energy flow types, and re-sectioned bank profiles. RHS classified the watercourse as being 'severely modified' and the River Condition Assessment determined that the reach was in 'Fairly Poor' condition.

7.6.152. Aquatic macroinvertebrate survey on the Leigh Brook in 2020 identified the presence of an assemblage that reflects its predominant sediment and flow and character i.e. a community that is indicative of a heavily sediment watercourse bed condition and not sensitive to flow reduction. No protected or notable species were recorded, and the non-native New Zealand mud snail formed a dominant component of the assemblage. The Leigh Brook is not considered to be suitable for populations of white-clawed crayfish due to the predominance of silty substrates, lack of suitable in-channel and marginal habitats and intermittent flow character.

7.6.153. Only one in-channel macrophyte species, fool's watercress, was recorded during the 2020 survey, with its distribution in the channel limited by shading from both banks of the watercourse. No protected, notable or invasive species were recorded.

7.6.154. The Leigh Brook was not screened in for detailed fish survey due to the channel not exhibiting suitable habitat for the survey type and the fact that the watercourse

[124] Maddock, A. (ed) (2011). *UK Biodiversity Action Plan Priority Habitat Descriptions – Rivers*. Online: https://data.jncc.gov.uk/data/01d6ab5b-6805-4c4c-8d84-16bfebe95d31/UKBAP-BAPHabitats-45-Rivers-2011.pdf

experiences intermittent flow periods. It should be noted that the watercourse may support minor fish species such as 3-spined stickleback and minnow during periods when the channel conveys flow/holds water. During such periods the watercourse may act as a suitable resource for migrating European eel within the wider catchment, however, the brook is not considered in itself to be a viable resource for adult eel development.

7.6.155. As an intermittently flowing watercourse that is significantly altered from its natural state, the watercourse exhibits limited marginal and in-channel habitat complexity and supports a species poor aquatic ecological assemblage. Despite this, it is noted as likely to provide some limited value for aquatic species when temporarily acting to convey surface water flows, as well as providing important connectivity within the wider catchment. As a result, the Leigh Brook has been ascribed a value of Local importance for biodiversity.

Other Ordinary Watercourses

7.6.156. Ordinary Watercourses screened in for walkover survey, on the basis that they were identified as being potentially impacted by the Scheme, were visited in 2019. Drain 9, 11, 21 and 22 were not surveyed due to access restrictions. However, based on review of aerial imagery and professional judgement, they have been assumed to support similar habitats to the ordinary watercourses which were visited (Drain 8, Drain 10, Drain 12, Drain 14, Drain 15, Drain 16, Drain 20 and MW3).

7.6.157. These Ordinary Watercourses were identified as minor tributary systems and heavily managed drainage ditches with limited habitat complexity, typically choked with terrestrial herbs and scrub (indicating their ephemeral nature) and/or shaded by trees.

7.6.158. Due to their straightened planforms and drainage function they exhibited a limited range of habitat typologies for aquatic species. They are considered likely to provide only limited value for aquatic species when temporarily acting to convey surface water flows.

7.6.159. Information collected during the aquatic walkover survey for other ordinary watercourses were transposed to the Ditch Condition Assessment[125]. All of the watercourse ditch condition assessments classified them as being in 'Poor' condition.

7.6.160. Aquatic species were not screened in for survey, as it was identified that the unnamed Ordinary Watercourses within the study area potentially impacted by the Scheme did not exhibit suitable habitat for the detailed survey type. Assessment of importance value is considered to be adequately made using walkover survey information only.

7.6.161. Based on the information that is available concerning habitat condition and function, the predominantly agricultural setting, and the limited availability of suitable habitat for aquatic species, the other Ordinary Watercourses have been ascribed a value of Local importance for biodiversity.

Aquatic habitats and species – standing waterbodies

7.6.162. Seventeen ponds (waterbodies <2 ha in size) were identified within the study area (see Technical Appendix 7.12 – Aquatic Ecology Survey (Aapplication document TR010063~~—~~/APP/-6.15) for further details), their location is shown in Figure 7-12A.

7.6.163. HSI pond survey data have been reviewed where available (see Technical Appendix 7.11 – Great Crested Newt Survey [~~(~~Aapplication document TR010063/~~—~~APP/-6.15]~~)~~). These data identified a range of broad pond habitat typologies, that include ephemeral ponds, small ponds set within woodland and hedgerows, and ornamental ponds.

7.6.164. None of the ponds have been screened in for detailed pond habitat/aquatic species surveys e.g. Predictive System for Multimetrics (PSYM)[126] or further assessment, as no pond habitat loss or other potential impact pathways have been identified in relation to the Scheme.

[125] As described under the Biodiversity Metric 3.0 guidance.

7.6.165. In the absence of detailed pond surveys, the ponds have 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 within the region. Ponds have been ascribed a value of Local importance for biodiversity (this excludes any valuation for great crested newts, which is considered as a separate resource in its own right).

Summary of receptors

7.6.166. Table 7-7~~Table 7-7~~ below provides a summary of the biodiversity resources and their value.

Table 7-7 - Biodiversity resources and their Importance

Biodiversity R~~r~~esource	Importance
Designated S~~s~~ites	
Wye Valley and the Forest of Dean Bat Sites SAC	International
Walmore Common SPA/Ramsar Site	International
Severn Estuary SAC/SPA/Ramsar Site	International
Cotswold Beechwoods SAC	International
Coombe Hill Canal SSSI	National
Non-statutory designated nature conservation sites	County
Terrestrial habitats	
Terrestrial habitat - Veteran trees (irreplaceable habitat)	National
Terrestrial habitat - Broadleaved semi-natural woodland / lowland mixed deciduous woodland priority habitat	County
Terrestrial habitat – Unimproved neutral grassland / lowland meadow priority habitat	County
Terrestrial habitat - Traditional orchards at Millhouse Farm and Hayden Hill Fruit Farm and potentially present noble chafer population	County
Terrestrial habitat – Stanboro Lane orchard habitat complex and potentially present noble chafer population	County
Terrestrial habitat – Hedgerows priority habitat	Local
Terrestrial habitat – A4019 habitat complex	Local
Terrestrial habitat – Moat Lane habitat complex	Local
Terrestrial habitat - M5 Junction 10 and motorway embankments habitat complex	Local
Terrestrial habitat – B4634 habitat complex	Local
Other terrestrial habitats	Less than Local
Species	
Bats	Regional
Dormouse	County
Badger	Less than Local

Biodiversity Rresource	Importance
Otter	County
Water Vole	N/A (likely absent)
Other priority mammals	Local
White-clawed crayfish	N/A (likely absent)
Wintering birds	Local
Breeding birds (excluding barn owl)	Local
Barn owl	County
Reptiles	Local
Great crested newt	County
Common toad	Local
Terrestrial invertebrates (excluding noble chafer)	Less than Local
Protected and priority plant species	N/A (likely absent)
INNS plant species	Less than Local
Aquatic habitats	
River Chelt	County
Leigh Brook	Local
Other Ordinary Watercourses	Local
Standing waterbodies (not including assessment for great crested newt)	Local

7.7. Potential impacts

Scoped out biodiversity resources

Biodiversity resources considered to be absent

7.7.1. Biodiversity resources that are considered to be likely absent from the study area as a result of desk study and field survey have been scoped out of further assessment, as they will not be affected by the Scheme. This includes water vole, white-clawed crayfish and protected and priority plants.

Biodiversity resources where there is absence of an impact pathway

7.7.2. Similarly, biodiversity resources that were recorded during the desk study and field surveys but where there is absence of an impact pathway, have also been scoped out of further assessment. These are discussed in the paragraphs below.

Wye Valley and Forest of Dean Bat Sites SAC

7.7.3. The Wye Valley and Forest of Dean Bat Sites SAC has been scoped out from the remainder of this assessment. At a distance of 21 km from the Scheme, separated by towns, villages and major roads, this is well beyond the zone of influence for any Scheme impacts relating to direct habitat loss, habitat degradation, habitat fragmentation or disturbance (via noise/vibration or artificial lighting). The distance is also considered to be too great for there to be a significant functional linkage between the Scheme and the qualifying feature bat populations. This is because the distance is at least seven times

larger than the core sustenance zones[127] identified by the BCT[56] for lesser horseshoe bats (2 km) and greater horseshoe bats (3 km)[128]. In addition, the SAC is more than 200 m from the ARN for the Scheme and, as a result, will not be impacted by air quality pollution impacts. Further details are provided within Technical Appendix 7.13 – Habitats Regulations Assessment – Screening (Aapplication document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Walmore Common SPA and Ramsar Site

7.7.4. Walmore Common SPA and Ramsar Site has been scoped out of this assessment. The qualifying feature of the SPA and Ramsar Site, Bewick's swan, was not identified during breeding or wintering bird surveys. No records of Bewick's swan were provided by GCER and a review of existing literature indicated that the agricultural grassland habitats surrounding the Scheme are not key areas for populations of Bewick's swan[129]. The results of the wintering and migratory bird surveys and desk study therefore indicate that Bewick's swan does not regularly use or is dependent on the habitat in the vicinity of the Scheme. There is no hydrological connection between the Scheme and the SPA/Ramsar Site, so no hydrological impacts are anticipated. The SPA/Ramsar Site is also more than 200 m from the ARN for the Scheme and, as a result, will not be impacted by air quality pollution impacts. Further details are provided within Technical Appendix 7.13 – Habitats Regulations Assessment – Screening (Aapplication document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Cotswold Beechwoods SAC

7.7.5. Cotswold Beechwoods SAC has been scoped out of this assessment. At a distance of 7.4 km south of the Scheme, with no hydrological connection and located beyond the ARN for the Scheme, the only potential impact pathway between the Scheme and the Cotswold Beechwoods SAC was the potential for increased recreational pressure on the SAC. This could occur as a result of the Scheme facilitating housing developments within a 15.4 km zone of influence around the SAC, identified in the Cotswold Beechwoods SAC Recreation Mitigation Strategy[130] as an area within which housing growth may result in an increase in recreational use of the SAC. The potential for significant effects in combination with other projects was assessed and, following a review of planning policies, potential for in-combination effects as a result of the Scheme and surrounding housing developments was discounted. Further details are provided within Technical Appendix 7.13 – Habitats Regulations Assessment - Screening (Aapplication document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Severn Estuary SPA

7.7.6. The Severn Estuary SPA, located approximately 47.5 km downstream of the Scheme, has been scoped out of this assessment, on the basis that:

- Water quality impacts via the release of pollutants from the Scheme into the watercourse network upstream of the Seven Estuary SPA would be eliminated by dilution over the distance of at least 40 km that any pollutants would have to travel. Furthermore, pollution prevention measures are part of the embedded mitigation for the Scheme.
- Potential for changes in air quality to supporting habitats within the SPA, or to functionally linked habitats, has been discounted on the basis of the distance between the designated site and any construction activity and the ARN.
- The results of wintering and migratory bird surveys indicate that the habitats in the vicinity of any construction activity and the ARN are not functionally linked to the Severn Estuary SPA.

[127] 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.
[128] CSZs specific to the Wye Valley and Forest of Dean Bat Sites SAC have not been published.
[129] 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.
[130] Liley, D. & Panter, C. (2022). Cotswold Beechwoods SAC Recreation Mitigation Strategy. Unpublished report by Footprint Ecology.

- The Scheme would not add to any water quality or air quality effects, or to any effects on qualifying bird species associated with other plans and projects.
- There are policies in place to ensure that potential for in-combination recreational pressure on Coombe Hill Canal SSSI, which has been shown to be functionally linked to the Severn Estuary SPA[111], as a result of housing developments that the Scheme will facilitate, do not occur.

7.7.7. Further details are provided within Technical Appendix 7.13 – Habitats Regulations Assessment - Screening (Aapplication document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Coombe Hill Canal SSSI

7.7.8. Recreational pressure on Coombe Hill Canal SSSI as a result of the Scheme has been discounted as discussed above. At a distance of 1.9 km from the Scheme, this is beyond the zone of influence for any Scheme impacts relating to direct habitat loss, habitat degradation, habitat fragmentation or disturbance (via noise/vibration or artificial lighting). It is acknowledged that there is a hydrological connection between the River Chelt and Coombe Hill Canal SSSI at times of flooding, when flow is reversed/backs up and water floods from the River Chelt into Coombe Hill Canal SSSI. This happens over 6 km downstream from the Scheme, with water flowing into the SSSI. Therefore, for the purposes of this assessment, there is not considered to be a hydrological connection between the SSSI and the Scheme. The SSSI is beyond the ARN for the Scheme. Hydrological impacts or air quality pollution impacts to Coombe Hill Canal SSSI are therefore not anticipated.

Non-statutory designated nature conservation sites

7.7.9. Hayden Sewage Treatment Works unconfirmed Local Wildlife Site, located approximately 680 m south of the Scheme Boundary, is located beyond the zone of influence for any impacts relating to direct habitat loss, habitat degradation, habitat fragmentation or disturbance (via noise/vibration or artificial lighting).

7.7.10. Road traffic is a source of nitrogen oxides (NOx) emissions, a pollutant that can have adverse effects on plants and habitats as a result of nitrogen deposition, which can cause nutrient enrichment of the soil and changes to the soil pH. This can have adverse effects on sensitive habitats. However, the results of the air quality assessment have identified air quality improvements at the seven non-statutory designated nature conservation sites located within 200 m of the ARN (Norton (A38) Conservation Road Verge; Pegmore Farm, The Leigh 'Meadow 2' potential LWS; Cotswold Farm, The Leigh Conservation Road Verge; Tewkesbury Nature Reserve Potential LWS; Tewkesbury Rail Line (Disused) LWS; Walton Cardiff Ponds LWS; and Hayden Sewage Treatment Works), with either no change or a reduction in nitrogen deposition rate estimated at all locations with the Scheme in place. Further detail is included in Chapter 5 – Air Quality (Aapplication document TR010063 – APP – 6.3). Therefore, these resources are not considered further within this report.

Terrestrial habitat - veteran trees

7.7.11. The veteran tree within the Scheme Boundary will be retained. It is located approximately 50 m east of Withybridge Lane, along the boundary of an area that will be subject to a right to drainage capture only. No construction works will be undertaken here, with the closest works approximately 170 m east, associated with the construction of the Link Road. Natural England and the Forestry Commission's standing advice[131] states that a buffer zone around a veteran tree should be at least 15 times larger than the diameter of the tree, or 5 m from the edge of the tree's canopy, whichever is greater, and should comprise semi-natural habitats such as woodland, grassland or scrub. The veteran tree is 153 cm in diameter with a canopy spread of 10 m, so the buffer zone is considered to protect this tree adequately in line with current best practice guidance. No construction phase impacts are therefore anticipated. Consideration has also been given to potential indirect impacts as a result of nitrogen deposition from road traffic emissions during operation. The air quality assessment indicates that there will be a reduction in the

[131] https://www.gov.uk/guidance/ancient-woodland-and-veteran-trees-protection-surveys-licences. Accessed: August 2022

nitrogen deposition rate estimated at the veteran tree with the Scheme in place as a result of reductions in traffic along Withybridge Lane. The Link Road carriageway is over 200 m from the veteran tree, which is beyond the accepted distance for potential operational air quality impacts, so emissions from this road do not affect the veteran tree. Further detail is included in Chapter 5 – Air Quality (Aapplication document TR010063 – APP – 6.3). Therefore, no impacts to this veteran tree are anticipated and this resource is not considered further within this report. No impacts are anticipated to the more distant veteran tree identified.

Terrestrial habitat – broadleaved semi-natural woodland/lowland mixed deciduous woodland priority habitat; Moat Lane habitat complex; B4634 habitat complex

7.7.12. No impacts are anticipated to the broadleaved semi-natural woodland, which has been assigned a value of County importance, and the B4634 habitat complex and Moat Lane habitat complex which have been assigned a value of Local importance. The single copse of broadleaved semi-natural woodland and the Moat Lane complex of habitats are located approximately 80 m south of the Scheme Boundary. The B4634 complex of habitats are located adjacent to the Scheme Boundary, but in this location only minor works including installation of signage is required, and the area is located over 100 m from any more intrusive works. Taking into consideration these distances no impacts are anticipated.

Terrestrial habitat – traditional orchards at Millhouse Farm and Hayden Hill Fruit Farm

7.7.13. Traditional orchards at Hayden Hill Fruit Farm, Millhouse Farm and north of Stanboro Lane which may support a population of noble chafer~~Terrestrial invertebrates~~ have been assigned a precautionary value of County importance. ~~, assuming the presence of a key population of noble chafer at traditional orchards at Hayden Hill Fruit Farm, Millhouse Farm and north of Stanboro Lane. Traditional orchards have also been assigned a value of County importance.~~ The Scheme would not impact traditional orchard habitat at Millhouse Farm and Hayden Hill Fruit Farm. This habitat is located outside of the Scheme Boundary. At Millhouse Farm the traditional orchard habitat is located approximately 100 m west of the Scheme Boundary; and at Hayden Hill Fruit Farm the traditional orchard habitat is located approximately 60 m south-east of the Scheme Boundary. Therefore, there would be no direct impacts as a result of habitat loss. No indirect impacts to either the traditional orchard habitat at Millhouse Farm or Hayden Hill Fruit Farm or the noble chafer population, if present, are anticipated during construction. Consideration has also been given to potential indirect impacts as a result of nitrogen deposition from road traffic emissions during operation, noting that this habitat type does not warrant detailed assessment as per LA 105[29]. The two locations are discussed below:

- The traditional orchard at Millhouse Farm is located adjacent to Withybridge Lane. The air quality assessment indicates that there will be a reduction in nitrogen deposition rate along Withybridge Lane with the Scheme in place. The Link Road carriageway is approximately 200 m from the traditional orchard, which is beyond the accepted distance for potential operational air quality impacts.
- At Hayden Hill Fruit Farm there is a human air quality receptor (R_36 Pilgrove Cottage, B4634) where the air quality assessment indicates that there will be a reduction in NOx emissions with the Scheme in place resulting in a reduction in reported NO_2 concentrations in the opening year at receptor R_36. Further detail is included in Chapter 5 – Air Quality (Aapplication document TR010063 – APP – 6.3).

7.7.14. Therefore, no impacts to the traditional orchard habitats at Millhouse Farm or Hayden Hill Fruit Farm, or the noble chafer population, if present, are anticipated and this resource is not considered further within this report.

Summary of scoped out biodiversity resources

7.7.15. Those biodiversity resources that have been scoped out are summarised in Table 7-8 below.

Table 7-8 - Scoped out Biodiversity Resources

Biodiversity Resource (Iimportance)	Reason for Sscoping Oout
Wye Valley and the Forest of Dean Bat Sites SAC (International)	Resource would clearly not be impacted by the Scheme.
Walmore Common SPA/Ramsar Site (International)	Resource would clearly not be impacted by the Scheme.
Cotswold Beechwoods SAC (International)	Resource would clearly not be impacted by the Scheme.
Severn Estuary SPA (International)	Resource would clearly not be impacted by the Scheme.
Coombe Hill Canal SSSI (National)	Resource would clearly not be impacted by the Scheme.
Non-statutory designated nature conservation sites (County)	Resource would clearly not be impacted by the Scheme.
Terrestrial habitat – veteran trees (National)	Resource would clearly not be impacted by the Scheme.
Terrestrial habitat - Broadleaved semi-natural woodland/lowland mixed deciduous woodland priority habitat (County)	Resource would clearly not be impacted by the Scheme.
Terrestrial habitat - Traditional orchards at Millhouse Farm and Hayden Hill Fruit Farm and potentially present noble chafer population (County).	Resource would clearly not be impacted by the Scheme.
Terrestrial habitat – Moat Lane habitat complex (Local)	Resource would clearly not be impacted by the Scheme.
Terrestrial habitat – B4634 habitat complex (Local)	Resource would clearly not be impacted by the Scheme.
Water Vole (N/A)	Desk study and field surveys indicate likely absence.
White-clawed crayfish (N/A)	Desk study and field surveys indicate likely absence.
Protected and priority plant species (N/A)	Desk study and field surveys indicate likely absence.

7.7.16. Biodiversity resources that are of less than local value are not considered to be important biodiversity resources and are therefore not included in the impact assessment. This includes other terrestrial habitats, badger, terrestrial invertebrates (excluding noble chafer) and INNS. However, appropriate mitigation is included in Section 7.8 where necessary to ensure legal compliance.

Important biodiversity resources

7.7.17. The following biodiversity resources are considered in the assessment as a result of their ecological importance being Local or greater and the predicted impacts of the Scheme:

- Severn Estuary SAC/Ramsar Site
- Terrestrial habitat – unimproved neutral grassland/lowland meadow priority habitat
- Terrestrial habitat – Stanboro Lane orchard habitat complex and potentially present noble chafer population
- Terrestrial habitat – Hedgerows priority habitat
- Terrestrial habitat – A4019 habitat complex
- Terrestrial habitat – M5 Junction 10 and motorway embankments habitat complex

- Bats
- Dormouse
- Otter
- Other priority mammals
- Breeding birds (excluding barn owl)
- Wintering birds
- Barn owl
- Reptiles
- Great crested newt
- Common toad
- River Chelt
- Leigh Brook
- Other Ordinary Watercourses
- Standing waterbodies

7.7.18. Following the data gathering exercises from both the desk study and field surveys, and review of the Scheme details, the study area, or EZoI, has been reviewed and finalised for these remaining important biodiversity resources, as described in Table 7-9 below. Designated sites are not included in the table below, as potential impacts on each individual designated site identified within the original study area have already been assessed, and those where no impact would occur have been scoped out.

Table 7-9 - Final EZoI for impact assessment

Biodiversity Rresource (Iimportance)	Distance from the Scheme Boundary	Justification for Aany Cchange from Iinitial EZoI
Terrestrial habitat – unimproved neutral grassland/lowland meadow priority habitat	200 m	No change
Terrestrial habitat – Stanboro Lane orchard habitat complex and potential noble chafer population	200 m	No change
Terrestrial habitat – Hedgerows priority habitat	200 m	No change
Terrestrial habitat – A4019 habitat complex	200 m	No change
Terrestrial habitat – M5 Junction 10 and motorway embankments habitat complex	200 m	No change
Bats	250 m for potential impacts	No change

Biodiversity Rresource (Iimportance)	Distance from the Scheme Boundary	Justification for Aany Cchange from Iinitial EZoI
	to foraging and commuting habitat. 40 m for bat roosts.	
Dormouse	250 m	No change
Otter	250 m	The study area for otter has been reduced from 500 m to 250 m from the Scheme Boundary. An initial 500 m study area was useful in order to understand the distribution of otters from within a wider area, providing important contextual information. It also meant that any changes to the Scheme design could likely be accommodated. However, now that the Scheme design has progressed, impacts to otters over such an area are not anticipated, and 250 m is considered to be the absolute maximum distance over which there would be impacts to otters.
Other priority mammals	Within the Scheme Boundary	The study area for priority mammals has been reduced from 250 m to within the Scheme Boundary only. This is considered to be the maximum area over which these species would be impacted, taking into account their sensitivities and level of protection, considering that they are mobile species, and given the availability of suitable habitat in the wider area.
Breeding birds	250 m	No change
Wintering birds	250 m	No change
Barn owl	200 m	The study area for barn owl has been reduced from up to 1.5 km to 200 m. An initial 1.5 km study area was useful in order to understand the distribution of barn owls from within a wider area, providing important contextual information. It also meant that any changes to the Scheme design could likely be accommodated. However, now that the Scheme design has progressed, impacts to barn owls over such an area are not anticipated, and 200 m is considered to be the absolute maximum distance over which there would be impacts to barn owl. This is in line with guidance on the study area for impacts as a result of online road improvements schemes[132].
Reptiles	50 m	The study area for reptiles has been reduced from 250 m to within 50 m of the Scheme Boundary. This is considered to be the maximum area over which these species would be impacted, taking into account their sensitivities, considering that they are mobile species, and given the availability of suitable habitat in the wider area.

[132] Shawyer (2011) Barn Owl *Tyto alba* Survey Methodology and Techniques for use in Ecological Assessment. Developing Best Practice in Survey and Reporting. IEEM, Winchester

Biodiversity Rresource (Iimportance)	Distance from the Scheme Boundary	Justification for Aany Cchange from Iinitial EZoI
Great crested newt	500 m	The study area for great crested newts remains the same, as this species typically uses suitable terrestrial habitat up to 500 m from a breeding pond.
Common toad	Within the Scheme Boundary	The study area for common toad has been reduced from 250 m to within the Scheme Boundary only. This is considered to be the maximum area over which these species would be impacted, taking into account their sensitivities and level of protection, considering that they are mobile species, and given the availability of suitable habitat in the wider area.
River Chelt	2 km	No change
Leigh Brook	2 km	No change
Other Ordinary Watercourses	2 km	No change
Standing waterbodies	2 km	No change

7.7.19. The following general impacts have been identified.

General construction impacts

7.7.20. A highways scheme can have impacts on biodiversity in a number of ways during construction and operation. General construction impacts are as follows:

- Permanent habitat loss (e.g. loss of land comprising habitats that plants and animals rely on, and loss of habitats themselves).
- Temporary habitat loss (e.g. land used during construction that is subsequently to be restored).
- Habitat degradation (e.g. through sediment release, pollution events, construction traffic, air quality impacts, and dust).
- Habitat severance and fragmentation affecting movements of protected and priority species.
- Injury or mortality of protected and priority species through construction activities.
- Disturbance from noise, light and vibration to protected and priority species.
- Changes to hydrological conditions.

General operation impacts

7.7.21. General operational impacts are as follows:

- Habitat degradation (e.g. through pollution events and air quality impacts).
- Injury and mortality of protected and priority species from collision with vehicles.
- Disturbance from noise, lighting and vibration to protected and priority species.

- Changes to discharge volume and water quality.
- Watercourse habitats may be affected through changes in hydro-morphological character both upstream and downstream of their location. Associated alterations to sediment delivery rates and changes in flow character have the potential to reduce morphological diversity and reduce habitat complexity.

7.8. Mitigation measures

Embedded mitigation

7.8.1. Some mitigation, compensation and enhancement measures are embedded at the design stage to minimise or compensate for impacts on biodiversity, or to provide enhancements. These are as follows and are shown on the Environmental Masterplan (Aapplication document TR010063 – APP 2.13). They are also detailed in the Register of Environmental Actions and Commitments (REAC) (Aapplication document ~~TR010063 – APP 7.4~~TR010063/APP/7.4).

Habitat/feature retention and creation measures

7.8.2. The landscape design for the Scheme, with regards to specific measures for biodiversity, has been developed from the following principles:

7.8.3. Existing vegetation is to be retained as far as possible. In particular, within areas of land temporarily required for topsoil storage or compounds, boundary features such as hedgerows will be retained. Any retained vegetation will be clearly demarcated with no allowance of vehicles or storage of materials within these areas. The root zones and canopies of trees and areas of woodland to be retained will be protected during construction. Measures for protection are included in the REAC.

7.8.4. Replacement of any habitat losses as a minimum to ensure no net loss of biodiversity, and creation of additional habitat to ensure a net gain in biodiversity.

7.8.5. Retention of the natural character of the area through planting locally native species.

7.8.6. Embankments on the M5 at the point where the River Chelt passes under the motorway have been designed so that the existing culvert does not require extending on either side of the motorway. Consequently, there will be no direct loss of river habitat or alterations to channel bed and banks in this location.

7.8.7. At the M5 junction, the embankments have been designed to enable the retention of an existing area of lowland meadow priority habitat along Stanboro Lane.

7.8.8. An area of farmland to the south east of the motorway junction (referred to as the flood storage area) will be transformed into an area supporting wetland habitats surrounded by woodland, scrub and species-rich grassland, whilst also fulfilling its role as a flood storage area. The area will incorporate a permanently wet area, plus ephemeral wet grassland pools. A channel will link the outfall of the attenuation basin to the Piffs Elm culvert which will regularly refresh the permanent waterbody to avoid stagnation. Depressions have been designed to include variations in bed topography, with shallow bank slopes to create drawdown zones and marginal shelves. The approach will be to lightly seed the ephemeral areas with wetland grass species and suitable marginal plants, allowing a degree of natural regeneration. Scrub and woodland planting will be designed to complement the wetland areas, and these areas together with the adjacent species-rich grassland will collectively create a habitat mosaic suitable for a range of species. The area will be monitored before a management plan is produced to suit the developing conditions and habitats.

7.8.9. The embankments along the Link Road will be planted with blocks of woodland and hedgerows with trees. The A4019 planting comprises hedgerows and trees to the north and south, as well as trees within the central reserve and areas of species rich grassland. The focus of the planting around the junction itself and along the motorway is blocks of

woodland and linear belts of trees and shrubs, along with areas of species rich grassland. Attenuation basins and ditches will be sown with wet grassland and marginal planting. Areas of each habitat type to be created are shown in Table 7-10.

7.8.10. A REAC has been produced to ensure the establishment and success of habitat created to replace any habitats lost as a result of the Scheme.

7.8.11. Habitat creation would occur in suitable planting seasons as early as possible throughout the construction programme to reduce the time lag between habitat loss and habitat planting and establishment. It is acknowledged that in many areas the planting will not be possible until the Scheme is completed, which is currently programmed for the end of 2027, two and a half years after habitat is cleared. General habitat establishment times are likely to be approximately 20 years for woodland[133], three years for grassland with appropriate management[134] and five years for hedgerows (based on previous experience).

7.8.12. Road verge planting will follow National Highways Low Nutrient Grasslands policy[135], by removing nutrient-rich topsoil and adding subsoil or bare substrate to promote wildflower growth. The landscape planting will also comply with the Gloucestershire Highways and Biodiversity Guidance[16].

7.8.13. Culvert lengths have been minimised as far as possible and have been designed to ensure continuity of the natural bed substrates, flow and gradient through the structures, with culverts embedded 0.3 m below the surface, in accordance with best practice guidance[136,137,138,139].

7.8.14. The Order limits have been extended 100 m upstream of the River Chelt culvert and approximately 150 m upstream and 100 m downstream of the Link Road Bridge crossings. In these sections, the following measures will be implemented to improve hydromorphological and ecological diversity:

- Riparian and marginal aquatic planting to improve biodiversity and allow for dappled lighting.
- Bank reprofiling or the creation of berms and two stage channels to improve flood plain connectivity.
- Installation of in channel morphological features for example: riffle pool sequences and/or large wood.

7.8.15. On the Leigh Brook, downstream of the Leigh Brook culvert, a section of approximately 200 m of channel has been included within the Order limits for:

- Bank reprofiling.
- Re-meandering.
- Vegetation management.
- Installation of large wood.

[133] Herbert S., Hotchkiss A., Reid C. & Hornigold K. (2022). Woodland creation guide, Woodland Trust.
[134] Harris, P., Brearley, A. & Doick, K.J. (2014). Lowland Neutral Grassland – Creation and Management in Land Regeneration. BPG Note 17. Forest Research.
[135] Major Projects Delivery Services (October 2020), Low Nutrient Grasslands (version number MPI-85-102020)
[136] Environment Agency (2010). Fluvial Design Guide: Chapter 8 – working in the river channel. Available at: https://assets.publishing.service.gov.uk/media/60549ae1e90e0724c0df4619/FDG_chapter_8_-_Works_in_the_river_channel.pdf [Accessed: September 2021]
[137] Available at: https://www.ciria.org/ItemDetail?iProductCode=C689F&Category=FREEPUBS [Accessed September 2021]
[138] Environment Agency (2010). 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: September 2021].
[139] 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: 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: September 2021].

7.8.16. Table 7-10 shows the areas of each habitat type to be created.

Table 7-10 - Habitat Creation Areas

Habitat ~~t~~Type	Area/L~~l~~ength
Grassland with bulbs	3.56 ha
Species-rich grassland	22.56 ha
Woodland	15.98 ha
Scrub and linear belts of shrubs and trees	6.39 ha
Amenity tree and shrub planting	0.32 ha
Native species-rich hedgerow	2.52 km
Native species-rich hedgerow with trees	8.83 km (including 0.06 km associated with a ditch)
Scattered trees	257 individual trees
Waterbodies and associated planting	1.01 ha
Banks and ditches sown with wet grassland	5.16 ha
Wet grassland with marginal planting	5.34 ha

Proposed structures

7.8.17. Design measures include:

- River Chelt Link Road bridge will be a clear span structure with set-back abutments (approximately 4 m from the watercourse margin), thereby avoiding direct impacts to the in-channel and bank top habitats, ensuring fauna can continue to move along the watercourse unimpeded.
- Embankments on the M5 at the point where the River Chelt passes under the motorway have been designed so that the existing culvert does not require extending on either side of the motorway, and consequently there will be no direct loss of watercourse habitat or alterations to channel bed and banks in this location.

7.8.18. Two structures will be constructed to provide compensation for loss of confirmed/assumed bat roosts. One is located within the flood storage area and another is located just north of the A4019, to the east of Uckington. Further detail about mitigation specifically for bats is included in Technical Appendix 7.15 - Bat Mitigation Strategy (A~~a~~pplication document ~~TR010063 - APP 6.15~~TR010063/APP/6.15).

7.8.19. Two artificial badger setts have been incorporated into the design to provide compensation for the loss of two main badger setts.

Wildlife crossing features

7.8.20. The River Chelt Link Road bridge will be a clear span structure over the river, thereby ensuring fauna can continue to move along the river unimpeded.

7.8.21. A large underpass (5 m wide and 4 m high) will be constructed underneath the A4019 east of Junction 10 (the Withybridge (A4019) underpass). This will provide mitigation for bats that cross the existing A4019 to the east of the M5, providing a traffic free route for the bats across this road. The Withybridge (A4019) underpass will also provide traffic free access for pedestrians and equestrians across the A4019. Lighting will be provided

through the underpass, with the lights switched off between sunset and sunrise. Further detail about mitigation specifically for bats is included in Technical Appendix 7.15 - Bat Mitigation Strategy (~~application~~Application document ~~TR010063 - APP 6.15~~TR010063/APP/6.15). The underpass will also allow safe movement of other mammal species, reptiles and amphibians across the Scheme.

7.8.22. The following additional underpasses are also proposed which will allow safe movement of badgers and otters, as well as other mammals, reptiles and amphibians across the Scheme:

- To the south of the River Chelt, within 50 m of the watercourse, designed specifically for otters but with the capacity to be used by other species. The design will follow DMRB guidance[140], and will comprise a 900 mm pipe located above possible flood levels.
- An additional two underpasses are included along the Link Road (one north of the River Chelt and one to the south) at existing hedgerows where badger activity has been identified, designed for use by badger, as well as other mammals, reptiles and amphibians. The design will follow DMRB guidance[141], and will comprise at least 600 mm pipes. The approaches will be 'softened' with appropriate planting.
- In addition, a series of flood relief structures are incorporated underneath the Link Road so as not to impede the existing periodic movement of floodwater that occurs in a westerly direction out of the River Chelt from a point upstream of the Link Road. These are located to the north of the River Chelt and will also function as underpasses for badgers and other species. A ledge has been incorporated in the northern-most culvert to enable use by badgers and otters during flood conditions.

7.8.23. Mammal proof fencing will be installed to direct mammals into the underpasses and prevent them from accessing the carriageway. Fencing design will follow DMRB guidance[141] and will comprise chain link or welded mesh fencing attached to wooden post and rail fences using heavy duty staples. As a minimum standard, this will be at least 1 m high above ground with a lower section of 600 mm buried below ground, 300 mm down into the soil and a further 300 mm turned away from the fence in the direction from which badgers will approach. Where necessary (within 100 m of the River Chelt), badger and otter fencing can be combined, by adding a 300 mm mesh overhang at the top of the fence, angled away from the road. Planting will guide animals to safe crossing locations.

7.8.24. An otter ledge will be retrofitted within the existing River Chelt culvert beneath the M5, on the opposite side of the footbridge. Otters currently use the footbridge, but camera footage and observations have identified that it floods. Retro-fitting an otter ledge will provide safe passage during times of flood. The design will follow DMRB guidance[140]. The ledge will be 500 mm wide, 150 mm above the highest water level and will allow for 600 mm headroom.

7.8.25. Bat 'hop-overs' comprising tall planting at least 6 m high have been included within the landscape design at 11 strategic locations across the Scheme identified as bat crossing points. These aim to encourage bats to cross the road at a greater height, and thereby reduce potential collisions with vehicles. Further detail about mitigation specifically for bats is included in Technical Appendix 7.15 - Bat Mitigation Strategy (Aapplication document ~~TR010063 - APP 6.15~~TR010063/APP/6.15).

Pollution prevention measures

7.8.26. To mitigate the potential for a pollution incident to occur during construction, works will proceed following standard good practice working methods for environmental protection,

[140] Design Manual for Roads and Bridges Nature Conservation Advice in Relation to Otters. Volume 10, Section 4, Part 4. HA 81/99. (February 2001). Online: https://cieem.net/wp-content/uploads/2019/07/ha8199.pdf
[141] Design Manual for Roads and Bridges Mitigating against effects on badgers. Volume 10, Section 4, Part 2.HA 59/92. (February 2001). Online: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/351478/Design_manual_for_roads_and_bridges_--_mitigating_against_effects_on_badgers.pdf

which will adhere to GPPs[142] and CIRIA C715[143]. These detail good practice advice for undertaking works which may have the potential to cause water pollution, including management of fine sediment run-off from construction areas. This also includes use of designated, bunded areas away from sensitive biodiversity resources for fuel storage and refuelling.

7.8.27. The above pollution control measures will be secured along with other environmental protection measures via a REAC, which will be adhered to by all contractors involved in construction of the Scheme. The REAC includes the following measures:

- All debris arising from the construction and works will be effectively encapsulated and removed from site.
- No pollutants will enter drainage or run-off to a watercourse.
- The contractor will ensure that they have a robust Pollution Response Plan in place before works start.
- Any pollution incident will be contained and cleaned up immediately and reported.
- No storage of oils or chemicals will be allowed within 10 m of a watercourse.
- 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 and toolbox talks for all site operatives to make them aware of relevant constraints and requirements prior to commencing work on the Scheme.
- Clear demarcation of retained habitats and no allowance of vehicles or storage of materials within these areas.
- 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.
- Good working practices will be employed in order to minimise noise impacts during construction and operation. This includes fitting all vehicles, plant and tools with silencers and/or mufflers, and installing temporary noise barriers or other noise containment measures to minimise construction noise levels where possible. Low noise road surfacing will be used where practicable in order to reduce noise levels during the operation of the Scheme.
- The River Chelt Link Road bridge construction will be a single span precast beam bridge with integral full height reinforced concrete abutments, resting on a piled foundation (comprising 1 m diameter bored concrete pile). The use of pre-cast elements will minimise on-site concrete pouring.

Lighting measures

7.8.28. The Link Road will not be lit, apart from a short section at the junctions at the northern and southern ends.

7.8.29. Wildlife-friendly lighting is to be implemented throughout the Scheme, where lighting is required. Lighting columns are proposed to be 12 m mounting height, and it is proposed to use LED luminaires with a colour temperature of 2700k which emit no upward light. Colour temperature is in accordance with Bat Conservation Trust and Institution of Lighting Professionals guidance[144].

[142] [redacted]

[143] CIRIA (2006), CIRIA C648 Control of water pollution from linear construction projects technical guidance. London.

[144] Bat Conservation Trust & Institution of Lighting Professionals (2018). Guidance Note 08/18: Bats and Artificial Lighting in the UK.

7.8.30. Lighting is proposed along both sides of the A4019 from the Gallagher Retail Park (the eastern extent of the Scheme) to Junction 10 but incorporates two dark corridors to the east and west of Uckington, in locations that have been identified to be frequently used by commuting and foraging bats. This includes a 92 m section to the east of Uckington extending east to the West Cheltenham Fire Station, and a 150 m section west of Uckington extending west to Cooks Lane. The section to the east of Uckington will align with the dark corridor proposed as part of the North West Cheltenham Development Area.

Drainage measures

7.8.31. The operational drainage will be designed to minimise the risk of pollution from the road surface coming into contact with sensitive habitats.

7.8.32. Six attenuation basins will be created along the M5, A4019 and the Link Road. Attenuation basins will include features to enhance biodiversity, such as submerged and marginal planting; variations in bed topography; shallow bank slopes to create drawdown zones; island features; and marginal shelves. Additional surrounding planting will also be included to help embed the basin into the landscape.

7.8.33. For the M5 J10 and A4019, collection systems are to be a kerb and gully arrangement or combined drainage and kerbs as per the existing arrangement. Grassed channels will be introduced where space allows. Flows will be conveyed via pipes to new attenuation basins prior to discharge to watercourses via new ditches for at least 8 m upstream of the outfalls. Due to several private land parcels along the A4019 being retained, there is limited space to add additional open ditch features or swales. Flows are to be restricted to existing rates. Basins will include forebay areas to manage contaminants and contain spillages.

7.8.34. The Link Road includes roadside swales to collect runoff and convey it to new basins. Outgoing pipes from basins will discharge to new ditches at least 8 m upstream of the outfalls. Flows are to be restricted to greenfield runoff rates. Basins will include forebay areas to manage contaminants and contain spillages.

7.8.35. Several drainage ditches will need to be realigned as part of the Scheme. New drains will replace any lost due to encroachment, with like for like habitat as a minimum. These will be sown with a wet grassland seed mix of appropriate provenance and to represent geographical context. As part of the drainage strategy, where space allows, ditches have been given a sinuous planform to improve hydromorphological and biological diversity.

Impacts

7.8.36. In the paragraphs below, potential impacts are considered in more depth for each receptor, taking embedded mitigation into account but in the absence of the additional mitigation that is then described below in from paragraphs 7.8.136 onwards.

Impacts to designated sites

Severn Estuary SAC/ Ramsar Site

7.8.37. Desk study data and fish surveys have confirmed the presence of European eel, a feature of the Severn Estuary Ramsar Site, from within the River Chelt. Fish surveys have confirmed the potential presence of river lamprey[145], a feature of the Severn Estuary SAC and Ramsar Site, from within the River Chelt. In addition, the desk study data included records of Atlantic salmon and sea/brown trout, features of the Severn Estuary Ramsar Site, from the River Chelt. The following potential impact pathways were identified:

- Temporary reduction in the extent of functionally linked habitat available to migratory European eel, Atlantic salmon and sea trout associated with the Severn Estuary Ramsar Site, and river lamprey associated with the Severn Estuary SAC

[145] Two brook/river lamprey ammocoetes (young/larvae) were recorded. It is difficult to distinguish between brook and river lamprey when in the ammocoete stage. As a precaution, they are assumed to be river lamprey.

and Ramsar Site, in the event that dewatering part of the River Chelt channel is required during construction.

- Water quality impacts to functionally linked habitat within the River Chelt as a result of a pollution event during construction and operation, and consequent detrimental effects to migratory European eel, Atlantic salmon and sea trout associated with the Severn Estuary Ramsar Site, and river lamprey associated with the Severn Estuary SAC and Ramsar Site.
- Disturbance impacts to migratory European eel, Atlantic salmon and sea trout associated with the Severn Estuary Ramsar Site, and river lamprey associated with the Severn Estuary SAC and Ramsar Site, using functionally linked habitat within the River Chelt during construction as a result of noise and vibration.
- Injury or mortality to river lamprey ammocoetes associated with the Severn Estuary SAC and Ramsar Site using functionally linked habitat within the River Chelt if they are present within burrows in the sediment in the event that dewatering of part of the channel is required during construction.
- Fragmentation as a result of disturbance and pollution, which could result in barrier effects, with European eel, Atlantic salmon and sea trout associated with the Severn Estuary Ramsar Site, and river lamprey associated with the Severn Estuary SAC and Ramsar Site, unable to disperse or move along the River Chelt.

7.8.38. Technical Appendix 7.13 – Habitats Regulations Assessment – Screening (Aapplication document ~~TR010063 - APP 6.15~~TR010063/APP/6.15) concluded that if there was no mitigation, there is potential for impacts to occur in relation to European eel, Atlantic salmon and sea trout, qualifying features of the Severn Estuary Ramsar Site designation, and river lamprey, a qualifying feature of the Severn Estuary SAC and Ramsar Site designations.

7.8.39. No impact pathways were identified for the qualifying bird species of the Severn Estuary Ramsar Site or the qualifying habitats within the Severn Estuary SAC and Ramsar Site on the basis that:

- Although there is a direct hydrological connection between the Scheme and the Severn Estuary designations, at a distance of more than 40 km (via hydrological connection), it is considered that the potential for direct impacts via release of pollutants from the Scheme would be eliminated by dilution. LA 113[146] states that "for assessment of impacts associated with soluble pollutants, outfalls within 1 km (measured along the watercourse) shall be aggregated for the purposes of cumulative assessment[147]". It therefore follows that soluble pollutants are considered to be sufficiently diluted beyond 1 km. Furthermore, pollution prevention measures are part of the embedded mitigation for the Scheme.
- Potential for changes in air quality to habitats within the SAC/Ramsar Site, or to functionally linked habitats, has been discounted on the basis of the distance between the designated sites and any construction activity and the ARN, and the results of wintering and migratory bird surveys, which indicate that the habitats in the vicinity of any construction activity and the ARN are not functionally linked to the Severn Estuary Ramsar Site.
- The habitats within and surrounding the Scheme are not considered to provide a role in maintaining the Ramsar Site populations of qualifying bird species, or to be functionally linked to the Ramsar Site.
- The Scheme would therefore not add to any water quality or air quality effects, or to any effects on qualifying bird species associated with other plans and projects.

[146] Highways England (2020). Design Manual for Roads and Bridges LA 113 Road drainage and the water environment (formerly HD 45/09). (March 2020, version 1) Online: d6388f5f-2694-4986-ac46-b17b62c21727 (standardsforhighways.co.uk)

7.8.40. Following a detailed assessment of the potential impact pathways, it has been concluded in Technical Appendix 7.14 - Statement to Inform an Appropriate Assessment (SIAA) (Aapplication document ~~TR010063 - APP 6.15~~TR010063/APP/6.15) that there is a risk that the potential impacts could have adverse effects on the integrity of the Severn Estuary SAC/Ramsar Site alone. In the absence of additional mitigation measures, there is potential for moderate adverse impacts to the Severn Estuary SAC/Ramsar Site. Additional mitigation measures have been designed which will avoid the potential adverse effects identified, as detailed in paragraph 7.8.143.

Impacts to terrestrial habitats

Construction

7.8.41. The Scheme will result in habitat loss, as summarised in Table 7-11~~Table 7-11~~ below.

Table 7-11 - Habitat L~~l~~osses and G~~g~~ains

Habitat T~~t~~ype	Total A~~a~~rea/~~l~~Length within the Scheme Boundary	Total A~~a~~rea/L~~l~~ength R~~r~~etained	Area/L~~l~~ength L~~l~~ost (P~~p~~ermanent and T~~t~~emporary L~~l~~and T~~t~~ake)	Habitat Creation
Plantation woodland (broadleaved and mixed)	9.91 ha	1.78 ha	8.13 ha	15.98 ha of broadleaved plantation woodland will be created. In addition, 0.1 ha of woodland will be reinstated following temporary works.
Dense/scattered scrub	4.26 ha	0.03 ha	4.23 ha	6.39 ha of scrub will be created (including linear belts of shrubs and trees). In addition, 0.1 ha of scrub will be reinstated following temporary works.
Introduced shrub (vegetation dominated by shrub species that are not locally native)	0.07 ha	0 ha	0.07 ha	N/A
Scattered trees	112 individual trees	60 individual trees	52 individual trees	257 individual trees and 0.32 ha of amenity tree and shrub planting will be created.
Arable	88.26 ha	17.29 ha	70.97 ha	34.17 ha of arable land will be reinstated following temporary works.
Agricultural grassland/ cultivated land (Surveyed from aerial photograph interpretation)	2.62 ha	0.81 ha	1.81 ha	0.52 ha of agricultural grassland/cultivated land will be reinstated following temporary works.
Improved grassland	16.23 ha	10.41 ha	5.82 ha	3.77 ha of improved grassland will be reinstated following temporary works.

Habitat Ttype	Total Aarea/lLength within the Scheme Boundary	Total Aarea/Llength Rretained	Area/Llength Llost (Ppermanent and Ttemporary Lland Ttake)	Habitat Creation
Poor semi-improved grassland	5.14 ha	2.78 ha	2.36 ha	0.77 ha of poor semi-improved grassland will be reinstated following temporary works.
Semi-improved neutral grassland	13.38	1.75	11.64 ha	22.56 ha of species-rich grassland will be created. In addition, 5.3 ha of semi-improved neutral grassland will be reinstated following temporary works.
Unimproved neutral grassland	0.17 ha	0.07 ha	0.1 ha	
Tall ruderal	0.6 ha	0.18 ha	0.41 ha	N/A
Ephemeral/short perennial	0.22 ha	0 ha	0.22 ha	N/A
Amenity grassland	0.22 ha	0 ha	0.22 ha	3.56 ha of grassland with bulbs will be created.
Other (buildings, bare ground, hardstanding and residential garden)	22.75 ha	0.32 ha	22.43 ha	There will be approximately 30 ha of hardstanding upon completion of the Scheme, primarily as a result of new/wider roads.
Roadside/verge (surveyed from aerial photograph interpretation)	4.98 ha	0.31 ha	4.67 ha	N/A
River Chelt and Leigh Brook	0.89 km	0.85	0.02 km of the Leigh Brook will be lost due to the extension of the Leigh Brook culvert. 0.02 km of the River Chelt is beneath the Link Road crossing.	Of the retained length, approximately 0.37 km of the River Chelt upstream and downstream of the Link Road crossing and upstream of the existing M5 River Chelt culvert; and 0.22 km of the Leigh Brook downstream of the existing Leigh Brook culvert will be improved ecologically and hydromorphologically, as described in paragraphs 7.8.14 and 7.8.15.
Ditches	4.65 km	2.248 km	2.40 km	4.793 km of new ditch will be created. These banks and ditches will be seeded with a wet grassland seed mix, which equates to approximately 5.16 ha of wet grassland habitat.
Waterbodies and associated planting	0 ha	0 ha	0 ha	1.01 ha of this habitat type will be created within the flood storage area.

Habitat Ttype	Total Aarea/lLength within the Scheme Boundary	Total Aarea/LLength Rretained	Area/LLength Llost (Ppermanent and Ttemporary Lland Ttake)	Habitat Creation
Wet grassland with marginal planting	0 ha	0 ha	0 ha	5.34 ha of this habitat type will be created within depressions in the flood storage area and within the attenuation basins.
Species-rich hedgerows and species-rich hedgerows with trees (intact and defunct)	1.69 km	0.99 km	0.7 km	11.35 km of species-rich hedgerows will be created.
Species-poor hedgerows and species-poor hedgerows with trees (intact and defunct)	16.44 km	7.99 km	8.45 km	A number of retained hedgerows will be enhanced by reducing management, planting up gaps and increasing the species diversity, as discussed in paragraph 7.8.153 onwards.

7.8.42. There will be loss of habitats, primarily in the immediate vicinity of the motorway and existing Junction 10. 133.10 ha of habitat will be lost as a result of the Scheme, as well as 11.59 km of linear hedgerows.

7.8.43. Most of the area to be lost (103.68 ha) comprises habitats of low value for biodiversity, such as arable, species-poor semi-improved grassland, buildings, bare ground, hardstanding, improved grassland, amenity grassland and introduced shrub.

7.8.44. However, the following habitats/habitat complexes of Local value or greater will also be impacted:

- Terrestrial habitat – unimproved neutral grassland/lowland meadow priority habitat (County value).
- Terrestrial habitat – Stanboro Lane orchard habitat complex and potentially present noble chafer population (County value).
- Terrestrial habitat – Hedgerows priority habitat (Local value).
- Terrestrial habitat – A4019 habitat complex (Local value).
- Terrestrial habitat – M5 Junction 10 and motorway embankments habitat complex (Local value).

7.8.45. A small area (0.1 ha) of unimproved neutral grassland/lowland meadow priority habitat located in the verge south of the A4019 west of the M5 Junction 10 will be unavoidably lost beneath the footprint of the Scheme (another area to the north of Stanboro Lane will be retained).

7.8.46. At the Stanboro Lane orchard habitat complex, approximately 0.17 ha of habitat, comprising small areas of semi-improved neutral grassland, amenity grassland, roadside/verge and agricultural grasslandembe / cultivated land will be lost. As discussed in Technical Appendix 7.1 – Phase 1 Habitat Survey (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15), the boundary of the traditional orchard area shown on the MAGIC website is incorrect, and the orchard area itself is actually located approximately 40 m north of the Scheme Boundary rather than being within the Scheme Boundary. This habitat complex will therefore largely remain intact, with the most valuable

habitat within this complex, traditional orchard, unaffected (including the associated noble chafer population, if present).

7.8.47. 9.15 km of hedgerow will also be lost as a result of the Scheme.

7.8.48. At the A4019 habitat complex, approximately 1.96 ha of habitat will be lost, comprising small areas of buildings, hardstanding, ephemeral/short perennial, tall ruderal, scattered scrub, amenity grassland and semi-improved neutral grassland.

7.8.49. The majority of woodland and scrub that will be lost as a result of the Scheme, as detailed in Table 7-11~~Table 7-11~~ above, are from within the M5 Junction 10 and motorway embankments habitat complex. The mature residential gardens along Withybridge Gardens will also be lost as a result of the Scheme.

7.8.50. Overall, the proposed habitat creation will compensate for the effects of habitat loss and will enhance and improve the habitats on site through increasing the area and quality of more valuable habitats. For example, 8.13 ha of plantation woodland will be removed, and 15.98 ha of woodland will be created; 4.23 ha of scrub will be removed, and 6.39 ha of scrub will be created; 9.15 km of hedgerows will be removed, comprising species-rich and species-poor hedgerows, and 11.35 km of species-rich hedgerows will be created; the majority of grassland habitat to be removed is of low nature conservation value, and 22.56 ha of species-rich grassland will be created. In addition, 11.51 ha of wetland habitat will be created, comprising permanent and ephemeral waterbodies, ditches and associated wet grassland and marginal planting. Implementation of the REAC will ensure successful establishment, however, it is recognised that the benefits from these new habitat types will take some time to establish.

7.8.51. Additional mitigation is included below specifically to offset any residual impacts in relation to loss of unimproved neutral grassland / lowland meadow priority habitat.

7.8.52. Habitat creation will also contribute to a net gain in biodiversity for the Scheme and will contribute to the Gloucestershire Nature Recovery Network. Much of the area around the junction is identified as a high or medium priority for restoration or creation of woodland within the Nature Recovery Network[148]. Furthermore, much of the Scheme is identified as a Tree Opportunities Area on Gloucestershire's Natural Capital mapping[149]. In addition, much of the area within the Order limits is identified as a Wetland Opportunity Area on Gloucestershire's Natural Capital mapping, which the waterbodies and associated planting, wet grassland and marginal planting will all contribute to.

7.8.53. In addition to direct loss, habitats may also be subject to degradation as a result of air and water pollution. The embedded pollution prevention measures have been designed to ensure that pollution events to retained and newly created habitats during construction are avoided or minimised to a negligible level.

7.8.54. Movement of topsoil as a result of the Scheme could potentially result in the spread of INNS between different areas of the landscape.

7.8.55. Habitat loss of the County and Local value habitats described above would be a minor adverse impact. Once newly created habitats are established, there will be an overall increase in the total area of valuable habitats, resulting in long term benefits.

Operation

7.8.56. During operation, habitats may also be subject to degradation as a result of air and water pollution. The embedded pollution prevention measures have been designed to ensure that pollution events to retained and newly created habitats during operation are avoided or minimised to a negligible level. The Scheme will result in small increases in NOx levels and nitrogen deposition in localised areas adjacent to the highway as a result of predicted traffic increases (it should be noted that the terrestrial habitats do not require detailed air

[148] Further information at www.gloucestershirenature.org.uk
[149] The tree opportunities layer on Gloucestershire's Natural Capital mapping (https://naturalcapital.gcerdata.com/) is a scale from low to high, with the Scheme appearing to fit in the moderate to high zone

quality assessment as per LA 105). However, significant additional impacts are not anticipated, given the small scale changes anticipated in localised areas, and considering that surveys have shown that a range of habitat types have established and persisted adjacent to the busy M5 and A4019 corridors.

7.8.57. Construction of roads can result in habitat fragmentation and severance between previously connected areas of the landscape. This has impacts on the species which use the habitats as well as reducing the robustness and resilience of the habitats themselves. The habitats around the junction and along the A4019 are already highly fragmented, so this impact relates to the new Link Road in particular. At the Link Road, the embankments will be planted with blocks of woodland and hedgerows with trees, creating a strong north-east to south-west green corridor. North-west to south-east movement will be maintained by the incorporation of wildlife underpasses and hop-over planting, as well as the clear span bridge structure over the River Chelt. Planting along the A4019 will comprise hedgerows and trees to the north and south, as well as trees within the central reserve and areas of species rich grassland. This will create a more robust habitat network than is currently the case. In addition, consideration has been given to joining up with habitat in the wider landscape. For example, the planting along the M5 will link with existing highway planting. Furthermore, hedgerows to the north of the A4019 are being created and enhanced, and these link to hedgerows in the wider area and the green corridor along the Leigh Brook, ensuring that the landscape design functions at a landscape scale. Therefore, the habitat creation will offset the effects of habitat fragmentation.

7.8.58. Taking into account embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in minor adverse impacts to habitats during operation as a result of small scale, localised air quality effects.

Impacts to bats

Construction

7.8.59. Fifteen structures and one tree with confirmed bat roosts will be demolished or felled in order to facilitate widening of the A4019 and construction of the new M5 junction and associated slip roads. These structures/tree support 22 bat roosts (a number of structures support more than one roost).

7.8.60. A further 21 structures and trees with confirmed bat roosts are at risk of temporary disturbance during construction as a result of increased noise levels. These structures/trees support 26 bat roosts (a number of structures support more than one roost).

7.8.61. Roosts that will be lost or temporarily disturbed are detailed in Table 7-12~~Table 7-12~~.

Table 7-12 - Summary of B~~b~~at R~~r~~oosts to be L~~l~~ost (D~~d~~emolished, F~~f~~elled or T~~t~~emporarily ~~a~~Abandoned)

Species	Roost ~~t~~Type	Total N~~n~~umber D~~d~~emolished or F~~f~~elled	Total N~~n~~umber at R~~r~~isk of T~~t~~emporary D~~d~~isturbance D~~d~~uring C~~c~~onstruction
Common pipistrelle	Maternity roost (Assumed with limitations)	1	
	Day/hibernation		1
	Day/mating roost		1
	Night/feeding roost		1

Species	Roost ~~t~~Type	Total N~~n~~umber D~~d~~emolished or F~~f~~elled	Total N~~n~~umber at R~~r~~isk of T~~t~~emporary D~~d~~isturbance D~~d~~uring C~~c~~onstruction
	Day roost	6	10
	Day/transitional		1
Soprano pipistrelle	Maternity roost (Assumed with limitations)	1	
	Mating roost		1
	Day roost	4	1
Common or soprano pipistrelle	Day roost	1	
Lesser horseshoe	Day/night/feeding roost	4	2
	Transitional roost	1	
Noctule	Day roost	1	2
Barbastelle	Transitional roost	1	
Brown long-eared	Day roost	2	1
	Hibernation roost		1
Myotis (assumed to be Natterer's)	Day roost		1
Natterer's	Day roost		1
Whiskered	Transitional		1
Unknown	Unknown		1
Total		**22**	**26**

7.8.62. No impacts as a result of roost loss or disturbance are anticipated in relation to the remaining roosts identified given their location a sufficient distance beyond the footprint of the works. It has also been necessary to predict the impact to potential roosts. Further information about the approach taken is detailed within Appendix F of Technical Appendix 7.3 – Bat Surveys (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15). In relation to the 39 additional bat roosts that are predicted to be potentially present within structures within the survey area, the impacts presented in Table 7-13 are predicted. As explained in paragraph 7.4.38, the emerging 2023 survey work is confirming that a precautionary approach has been taken, and the predicted roosts and impacts presented here are likely to be an over-estimation.

Table 7-13 - Predicted Iimpacts to rRoosts pPotentially Ppresent within Uunsurveyed/Ppartially Ssurveyed Sstructures within the Ssurvey Aarea

Species Ggroup	Species/Sspecies Aassemblage and Ccategory Aaccording to Wray *et al*., (2010)[150].	Predicted Nnumber of Rroosts and Rroost tType i.e. Mmaternity or Ssmall Nnumbers of Bbats	Predicted Iimpact
Horseshoe	Lesser horseshoe (rarer)	1 potential maternity roost	Temporary disturbance
		5 roosts supporting small numbers of bats	3 lost, 1 permanent disturbance, 1 temporary disturbance
Void dwelling bats (excluding horseshoes)	Barbastelle (rarest) Natterer's/ serotine/Daubenton's (rarer) Brown long-eared (common)	5 roosts supporting small numbers of bats *1 rarest* *1 rarer* *3 common*	4 lost, 1 permanent disturbance
	Natterer's/serotine/Daubenton's (rarer)	1 potential maternity roost *1 rarer*	Lost
Crevice dwelling bats	Barbastelle (rarest) Nathusius' pipistrelle/Natterer's/Daubenton's/ whiskered/Leisler's/noctule/serotine (rarer) Common pipistrelle/soprano pipistrelle (common)	17 roosts supporting small numbers of bats *1 rarest* *6 rarer* *10 common*	7 lost, 4 permanent disturbance, 6 temporary disturbance
	Nathusius' pipistrelle/Natterer's/Daubenton's/ whiskered/Leisler's/noctule/serotine (rarer) Common pipistrelle/soprano pipistrelle (common)	3 potential maternity roosts *1 rarer* *2 common*	2 lost, 1 temporary disturbance
Hibernation roosts	Barbastelle Lesser horseshoe/Natterer's/serotine/ Nathusius' pipistrelle/Leisler's/ Daubenton's/whiskered/Brandt's/ noctule (rarer) Common pipistrelle/soprano pipistrelle/brown long-eared (common)	5 roosts supporting a solitary hibernating bat *1 rarest* *1 rarer* *3 common*	3 lost, 1 permanent disturbance, 1 temporary disturbance
	Lesser horseshoe/Natterer's/serotine/ Nathusius' pipistrelle/Leisler's/	2 roosts supporting larger numbers of hibernating bats	1 lost, 1 temporary disturbance

[150] Wray et al., Valuing Bats in Ecological Impact Assessment (CIEEM (2010) In Practice Number 70)

Species Ggroup	Species/Sspecies Aassemblage and Ccategory Aaccording to Wray *et al*., (2010)[150].	Predicted Nnumber of Rroosts and Rroost ttype i.e. Mmaternity or Ssmall Nnumbers of Bbats	Predicted limpact
	Daubenton's/whiskered/Brandt's/noctule (rarer) Common pipistrelle/soprano pipistrelle /brown long-eared (common)	*1 rarer* *1 common*	

7.8.63. There are 34 predicted additional tree roosts. These include 11 partially surveyed trees that would be felled and 23 unsurveyed/partially surveyed trees predicted to experience temporary disturbance. Table 7-13 presents the predicted impacts to the different types of roosts potentially present. This is a precautionary approach, and in reality it is likely that the number of additional roosts found to be present as a result of further survey, and therefore the actual impacts, are lower. As explained in paragraph 7.4.38, the emerging 2023 survey work is confirming this.

Table 7-14 - Predicted limpacts to Rroosts Ppotentially Ppresent within Uunsurveyed/Ppartially Ssurveyed Ttrees within the Ssurvey Aarea

Species/Sspecies Aassemblage and ccategory Aaccording to Wray *et al*., (2010)[151].	Predicted Nnumber of Rroosts and Rroost Ttype i.e. Mmaternity or Ssmall Nnumbers of Bbats	Predicted limpact
Barbastelle/Bechstein's (rarest) Natterer's, Daubenton's, whiskered, Brandt's, Nathusius' pipistrelle, Leisler's and / or noctule (rarer) Common pipistrelle/soprano pipistrelle (common)	18 roosts supporting small numbers of bats *~~1~~ 3 rarest* *5 rarer* *10 common*	8 lost, 10 temporary disturbance
Natterer's, Daubenton's, whiskered, Brandt's, Nathusius' pipistrelle, Leisler's and / or noctule (rarer) Common pipistrelle/soprano pipistrelle (common)	16 potential maternity roosts *5 rarer* *11 common*	3 lost, 13 temporary disturbance

7.8.64. To compensate for the known and additional predicted loss and temporary disturbance of roosts, the embedded mitigation includes two compensatory bat roost structures. The compensatory bat roost structures will be constructed prior to the demolition or felling of any bat roosts to ensure that compensation is in place. The two structures have been included in the eastern and southern quadrants and each will include a series of features suitable for both void dwelling and crevice dwelling bat species.

7.8.65. The majority of the key bat foraging and commuting locations identified will be retained. However, there will be some loss of vegetation along the River Chelt beneath the River Chelt Link Road Bridge, loss of woodland and scrub habitat south of Junction 10 extending to the River Chelt, some loss of vegetation along Stanboro Lane, hedgerow 86 will be lost and hedgerow 132 will be severed as a result of the Link Road. Loss of bat foraging and commuting habitat will be compensated for by the creation of replacement habitat, which includes a net increase in broadleaved woodland, hedgerow planting and the creation of species-rich grassland and scrub. These new habitats are likely to support an abundance of invertebrate prey providing foraging habitat for bats. The creation of strong linear planting features such as hedgerows, hedgerows with trees and woodland, will provide a

[151] Wray et al., Valuing Bats in Ecological Impact Assessment (CIEEM (2010) In Practice Number 70)

network of habitat features that connect to adjacent habitats to ensure bats can move around the landscape. There would be a period of reduced habitat availability during construction and as habitats become established, which could affect the bats' ability to commute and forage in these areas. However, retention of the majority of key bat foraging and commuting locations, combined with the availability of suitable habitat (consisting of hedgerows and woodland) in the wider area goes some way to offsetting this temporary impact.

7.8.66. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in a major adverse impact to bats during construction as a result of roost loss, as well as temporary loss of foraging and commuting habitat while new planting becomes established.

Operation

7.8.67. The Link Road will cross the River Chelt, which is an identified key commuting and foraging corridor for bats. The embedded mitigation measures include a clear span bridge over the River Chelt, thereby ensuring continued movement along this feature.

7.8.68. The construction of the Link Road will result in a number of hedgerows being severed, one of which (hedgerow 132) has been identified as a key commuting/foraging location. There are a number of bat roosts located between the M5 and the Link Road, and consideration has been given to whether they are at risk of fragmentation as a result of the Link Road. However, the embedded mitigation includes linear planting parallel to the Link Road to direct bats to the River Chelt, where bats can cross safely beneath the clear span bridge structure. Furthermore, 6 m tall vegetation (hop-overs) have been included as part of the landscape planting design to encourage bats to fly over the road at height. In addition, the Link Road will remain unlit, ensuring that bats are not deterred from using these vegetation features. Fragmentation as a result of the Link Road is therefore not anticipated.

7.8.69. The creation of an all-movements junction will necessitate the demolition of the existing overbridge and construction of a new roundabout junction over the M5, with removal of the two existing slip roads and the construction of four new slip roads. This will result in increased fragmentation of the habitats surrounding the existing Junction 10. As a result of these fragmentation impacts, the bats' usual foraging and commuting routes could be affected, potentially resulting in bats using alternative, less direct routes which could result in reduced fitness as a result of longer flight times between roosts and foraging areas, or injury or mortality to bats as a result of collision with vehicles if bats were to use the same or alternative routes. The inclusion of the Withybridge (A4019) underpass as part of the embedded mitigation, will allow bats to safely cross the A4019 without being at risk of collision or having to travel a longer route.

7.8.70. The A4019 is due to be widened, and this could potentially result in increased risk of collision, or longer flight times between roosts and foraging areas as a result of bats using alternative, less direct routes. However, given that there is already an existing road here, bats are already habituated to crossing this feature. The inclusion of the Withybridge (A4019) underpass as part of the embedded mitigation will allow bats to safely cross the A4019 without being at risk of collision, and the inclusion of hop-overs along the A4019 will also encourage bats to safely cross the A4019 at a height above the risk of collision. Where there are more than two lanes, vegetation will be included in the central reservation to effectively provide two hop-overs.

7.8.71. The A4019 is currently largely unlit. Lighting is proposed along both sides of the A4019 from the Gallagher Retail Park (the eastern extent of the Scheme) to Junction 10. Despite new lighting following ILP guidance GN08 Bats and Artificial Lighting[152], lighting a previously unlit road that bats may currently cross freely, could affect the long-term behaviour of bats in the area. This could result in alterations to the bats' commuting routes which may expose them to new risks and/or limit access to existing foraging habitat. Each lighting column will be warm light and have louvers installed to reduce backspill onto

[152] Bat Conservation Trust (2018). Guidance Note: Bats and Artificial Lighting in the UK.

adjacent commuting routes. Furthermore, two dark corridors have been included within the design east of Uckington and west of Uckington, with the section to the east of Uckington aligning with the dark corridor proposed as part of the North West Cheltenham Development Area. The inclusion of the Withybridge (A4019) underpass as part of the embedded mitigation located east of the M5 Junction 10 will allow bats to safely cross the A4019.

7.8.72. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in a minor adverse impact to bats during operation as a result of habitat fragmentation, the potential for increased collision with vehicles and avoidance of newly lit areas.

Impacts to dormice

Construction

7.8.73. Based on the results of the dormouse surveys, it is assumed that dormice are present to the north of the A4019 and to the east of the M5. The habitats in this area comprise mostly arable fields. However, hedgerows are present bounding the fields which provide connectivity between different areas to the north of the A4019, and scrub is present along the M5 verge, which provides connectivity further north.

7.8.74. Approximately 1.84 ha of suitable habitat, comprising hedgerows (0.48 ha) and scrub (1.36 ha) will be removed by the Scheme to the north of the A4019 and east of the M5. This area is estimated to support a total of four dormice. There are areas of suitable habitat to the north of the Scheme and links to the wider landscape that are considered likely to support any dormice from within the Scheme area that will be displaced temporarily until new habitat planting becomes established.

7.8.75. Hedgerow, scrub and woodland planting to the north of the A4019 will replace any habitat lost in this area with more, better quality species rich habitat. The new planting will strengthen the linear vegetation features within the Scheme and improve connectivity to the wider landscape.

7.8.76. The Scheme could temporarily increase habitat fragmentation and severance to the north of the A4019 and the east of the M5, until new hedgerow planting becomes established.

7.8.77. Vegetation clearance and Scheme construction could result in incidental mortality, injury or disturbance (noise, lighting and visual) to individuals and damage or destruction of nests (e.g., resting or breeding sites) during construction. Noise disturbance is not anticipated to negatively affect the population of dormice given that the utilised habitat is already adjacent to the M5 and the A4019, so any dormice present are likely to be acclimatised to noise. Lighting will be sensitively designed so as to avoid light spill onto retained habitats during construction.

7.8.78. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in a moderate adverse impact to dormouse during construction.

Operation

7.8.79. During operation, given that dormice are already acclimatised to noise in this location, operational impacts from noise are not anticipated. Lighting has been designed sensitively to minimise light spill onto newly created habitats. In particular, the hedgerow running parallel to the north of the A4019 will be illuminated to between 0.5 lux and 0.2 lux. This is comparable to a clear full moon[153]. Furthermore, stretches of vegetation to the east and west of Uckington will be completely unlit. Around the junction itself, the woody vegetation planting is largely illuminated to 0.5 lux or less, and lighting does not extend north along the M5. The hedgerows to be created north of the A4019 are beyond the lighting impacts of the Scheme. Therefore, operational impacts from lighting are not anticipated.

[153] Bat Conservation Trust and the Institution of Lighting Professionals (2018). Bats and artificial lighting in the UK: Guidance Note 08/18.

7.8.80. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in no change to dormice during operation.

Impacts to otters

Construction

7.8.81. The Scheme will not result in the removal of suitable otter aquatic and terrestrial habitats (including identified resting site features, which monitoring surveys identified to be of low value). The proposed works at M5 Junction 10 and along the A4019 are largely confined to existing hardstanding and road verge and adjacent habitats which are not considered to be suitable to support otter.

7.8.82. However, there is the potential for the Scheme to result in disturbance to commuting, foraging and resting otters during construction, particularly where works are located directly adjacent to suitable otter habitat (River Chelt, Leigh Brook and MW4). In addition, there is the possibility of degradation impacts to these habitats during construction via pollution events, although this would be avoided or minimised to a negligible level taking into consideration the embedded mitigation measures.

7.8.83. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in a negligible adverse impact to otters during construction as a result of temporary disturbance.

Operation

7.8.84. The Link Road will include a clear span structure over the River Chelt, and therefore the River Chelt channel and banks will be retained beneath. The installation of an otter underpass within 50 m to the south of the River Chelt and associated landscape planting, will minimise injury/mortality to otters as a result of collision with vehicles. An otter ledge will be retrofitted to the existing River Chelt culvert beneath the M5 to improve this crossing feature for otters. Two culverts which span the M5 (Leigh Brook culvert and Piffs Elm culvert) are considered unlikely to be used by commuting otters due to a lack of suitable habitat on both sides of the M5. Therefore, the proposed modifications to these structures are not anticipated to result in operational impacts to commuting otter.

7.8.85. There is potential for the Scheme to result in degradation to suitable otter habitat during operation via a pollution event, although this would be avoided or minimised to a negligible level taking into consideration the embedded mitigation measures.

7.8.86. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in no change to otters during operation.

Impacts to other priority mammal species

Construction

7.8.87. The Scheme will result in temporary removal of vegetation that supports hedgehog, brown hare, polecat and harvest mouse. Although vegetation clearance will be kept to a minimum and will be compensated for with habitat creation, there will be a short-term loss in habitat availability during the construction phase of the Scheme. There are large areas of suitable habitat surrounding the Scheme and links to the wider landscape that are likely to support priority mammal species that are displaced temporarily until newly planted habitats become established.

7.8.88. Habitat creation including grassland, scrub, hedgerow and woodland planting will result in a permanent long-term increase in the total area of suitable habitat available for priority mammal species.

7.8.89. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in a negligible adverse impact to priority mammal species during construction.

Operation

7.8.90. The Scheme could result in populations becoming fragmented, and collision with vehicles, but these impacts will be minimised through the installation of wildlife crossing features as part of the embedded design.

7.8.91. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in no change to priority mammal species during operation.

Impacts to breeding birds (excluding barn owl)

Construction

7.8.92. The Scheme will result in temporary loss of foraging and nesting habitat for breeding birds. Although vegetation clearance will be kept to a minimum and will be compensated for with habitat creation, there will be a short-term loss in habitat availability as newly created habitats become established.

7.8.93. Once established, habitat creation including hedgerow, scrub and woodland planting and species-rich grassland creation will result in a permanent long-term increase in the total area of suitable foraging and nesting habitat available to birds.

7.8.94. If there were no standard on site mitigation measures, there is also the potential to incidentally kill or injure individual birds and/or destroy nests and eggs during construction, particularly during vegetation clearance.

7.8.95. Construction activities in the vicinity of known Schedule 1 bird sites (surveys have indicated the presence of barn owl and kingfisher) could result in disturbance impacts which could prevent these bird species from using their entire territory. Barn owl are discussed in detail below as a separate biodiversity resource.

7.8.96. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in a negligible adverse impact to breeding birds during construction.

Operation

7.8.97. There is the potential for noise and visual disturbance to breeding birds during the operational phase of the Scheme, which may deter birds from foraging or nesting close to the Scheme. However, given that the M5 motorway and the A4019 already exist, birds are already habituated to a degree of noise and visual disturbance, and it is not considered that the Scheme would appreciably add to this during the operational phase.

7.8.98. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in no change to the breeding bird population during operation.

Impacts to wintering birds

Construction

7.8.99. The Scheme will result in temporary loss of foraging habitat for wintering birds. Although vegetation clearance will be kept to a minimum and will be compensated for with habitat creation, there will be a short-term loss in habitat availability as newly created habitats become established. Once established, habitat creation including hedgerow, scrub and woodland planting and species-rich grassland creation will result in a permanent long-term increase in the total area of suitable foraging habitat available to birds.

7.8.100. Construction activities could result in disturbance impacts which could prevent birds from using certain areas of habitat.

7.8.101. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in a negligible adverse impact to wintering birds during construction.

Operation

7.8.102. There is the potential for noise and visual disturbance to birds during the operational phase of the Scheme, which may deter birds from foraging close to the Scheme. However, given that the M5 motorway and the A4019 already exist, birds are already habituated to a degree of noise and visual disturbance, and it is not considered that the Scheme would appreciably add to this during the operational phase.

7.8.103. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in no change to the wintering bird population during operation.

Impacts to barn owl

Construction

7.8.104. No confirmed occupied nest sites have been identified within the survey area, and no impacts to any PNS are anticipated, so direct impacts to nesting barn owl are not anticipated. The two ARS are not within the footprint of the works, so do not require removal. Construction activities could, however, result in disturbance impacts which could prevent barn owls from using their entire territory, despite embedded mitigation measures to minimise noise and visual disturbance.

7.8.105. The Scheme will result in the loss of a small area (4.7 ha) of potential foraging habitat for barn owl at the eastern end of the A4019 and at the southern end of the Link Road. However, loss of this foraging resource makes up a very small part of the available foraging habitat in the wider area, and over 35 ha of grassland habitat~~s~~ will be created ~~(22.56 ha of species-rich grassland will be created)~~ which will replace this resource, once established. It is acknowledged that not all of this area will provide suitable foraging resource for barn owl due to inappropriate location and/or inappropriate management, however the areas along the Link Road, ~~and~~ adjacent to the River Chelt and within the flood storage area in particular are likely to be suitable, providing approximately 10 ha of barn owl foraging habitat. ~~.~~

7.8.106. There is the possibility of degradation impacts to foraging habitats during construction via pollution events, although this would be avoided or minimised to a negligible level through the embedded pollution prevention mitigation measures.

7.8.107. Given the absence of any occupied nest sites and the absence of impacts to PNS and ARS, considering the small amount of foraging habitat that will be impacted, but taking into account some temporary disturbance which may reduce the available territory for barn owl, in the absence of additional mitigation, there would be a moderate adverse impact to barn owl during construction on a precautionary basis.

Operation

7.8.108. During operation, there is potential for mortality from collision with vehicles due to changes in traffic and design of existing roads. Fledging barn owls from home ranges within the survey area are considered to be particularly at risk. Existing roads as opposed to the Link Road are considered the main impact to barn owl since the new Link Road will have a 'B-road' classification, single carriageway and a speed limit of 50 mph and will be classed as a 'minor road'. The majority of barn owl ranges contain minor roads, and it is expected that all barn owls are likely to encounter them on a regular basis. Traffic flow is projected to increase on the A4019 and Junction 10 slip roads (with provision of two new slip roads) as a result of the Scheme. The eastern stretch of the A4019 will also become dual carriageway as part of the Scheme, increasing the potential risk to barn owl due to increased width and number of traffic lanes[154]. The proposed speed limit largely remains

[154] Ramsden (2007). Barn Owls and Major Roads: Results and Recommendations from a 15-year Research Project. The Barn Owl Trust.

the same as the existing speed limit on the A4019, although it is proposed to decrease from 50 mph to 40 mph from just west of Uckington and continuing towards the east. However, given that these major roads are already in place, any existing barn owl territories exist despite the existing road network, so these changes to the road network are unlikely to displace barn owls.

7.8.109. Changes in woodland/hedgerow screening could also increase the risk of collision with vehicles, as low-flight obstructions are provided by continuous screening (such as woodland or hedgerow) above the height of 4 m set back no further than 3 m from the carriageway[155]. There is some non-continuous tall woodland and hedgerow around the junction, but screening along the A4019 is limited. The proposed A4019 planting comprises hedgerows and trees to the north and south, as well as trees within the central reserve. The focus of the planting around the junction itself and along the motorway is blocks of woodland and linear belts of trees and shrubs. Once established, this will replace and strengthen screening around the M5 junction and along the Link Road, but in the short term screening for barn owls will be reduced. Nevertheless, given that potential foraging habitat is typically away from the roads, it is considered unlikely that the collision risk would increase significantly.

7.8.110. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in a negligible adverse impact to barn owl during operation.

Impacts to reptiles

Construction

7.8.111. The Scheme will result in temporary removal of vegetation suitable for widespread reptile species. Although vegetation clearance will be kept to a minimum and will be compensated for with habitat creation, there will be a short-term loss in habitat availability during the construction phase of the Scheme. There are large areas of suitable habitat surrounding the Scheme and links to the wider landscape that are likely to support any reptiles that are displaced temporarily until newly planted habitats become established.

7.8.112. Habitat creation including grassland, scrub, hedgerow and woodland planting will result in a permanent long-term increase in the total area of suitable reptile habitat available. The new planting will strengthen the linear vegetation features within the Scheme and improve connectivity to the wider landscape.

7.8.113. There is also the potential to incidentally kill or injure reptiles during construction.

7.8.114. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in a negligible adverse impact to populations of widespread species of reptile during construction.

Operation

7.8.115. The Scheme could result in populations becoming fragmented, and collision with vehicles, but these impacts will be minimised through the installation of wildlife crossing features as part of the embedded design.

7.8.116. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in no change to populations of widespread species of reptile during operation.

[155] BirdWatch Ireland (April 2021) Survey and Mitigation Standards for Barn Owls to inform Planning, Construction and Operation of National Road Projects. Transport Infrastructure Ireland (publication number PE-ENV-07005).

Impacts to great crested newt

Construction

7.8.117. No waterbodies will be lost or directly impacted by the construction works or the operation of the Scheme and the embedded mitigation measures would avoid or minimise to a negligible level potential for any indirect impacts as a result of a pollution event.

7.8.118. Impacts to the metapopulation located approximately 470 m north from the Scheme will be minimal, with only 0.05 ha of dense scrub located approximately between 470 – 500 m from the nearest waterbody temporarily lost. Due to the distance of the nearest waterbody from the proposed works area, and taking into account the limited connectivity and availability of more suitable habitat closer to the waterbody, it is considered unlikely that great crested newts associated with this metapopulation would be present within the Scheme in anything other than at most small numbers.

7.8.119. For the metapopulation that is located approximately 100 m south of the Scheme, to the south of the A4019, the Scheme is likely to result in the loss of terrestrial habitat used as foraging and commuting habitat by this population. Only very minor works will be undertaken within 100 m of the waterbodies which form the metapopulation to the south of the A4019, resulting in a very small area of potentially suitable habitat (up to 0.01 ha) being affected approximately 90 m from the waterbodies. Within 100 m – 250 m of these waterbodies, works will result in the loss of approximately 1.0 ha of suitable habit including predominantly hedgerows and grass verge habitat. Beyond 250 m, up to 500 m, works will result in loss of approximately 0.6 ha of suitable habitat.

7.8.120. Habitat creation, including species-rich grassland, hedgerow, scrub and woodland planting, will result in a permanent long-term increase in the total area of suitable great crested newt terrestrial habitat available.

7.8.121. There is also the potential to incidentally kill or injure great crested newts during construction.

7.8.122. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in a moderate adverse impact to great crested newt during construction.

Operation

7.8.123. The Scheme could result in populations becoming fragmented and collision with vehicles, but this will be minimised through the installation of wildlife crossing features as part of the embedded design.

7.8.124. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in no change to great crested newt populations during operation.

Impacts to common toad

Construction

7.8.125. The Scheme will result in temporary removal of vegetation that supports common toad. Although vegetation clearance will be kept to a minimum and will be compensated for with habitat creation, there will be a short-term loss in habitat availability during the construction phase of the Scheme. There are large areas of suitable habitat surrounding the Scheme and links to the wider landscape that are likely to support individual common toads that are displaced temporarily until newly planted habitats become established.

7.8.126. Habitat creation including grassland, scrub, hedgerow and woodland planting will result in a permanent long-term increase in the total area of suitable terrestrial habitat available for common toad.

7.8.127. There is also the potential to incidentally kill or injure common toad during construction.

7.8.128. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in a negligible adverse impact to common toad during construction.

Operation

7.8.129. The Scheme could result in populations becoming fragmented, and collision with vehicles, but this will be minimised through the installation of wildlife crossing features as part of the embedded design.

7.8.130. Taking into account the embedded mitigation measures, and in the absence of additional mitigation, the Scheme would result in no change to common toad during operation.

Impacts to aquatic habitats and species

Construction

7.8.131. Risk to aquatic habitats and species may arise from in-channel works that include bed and bank alterations, new crossing structures, installation of bank protection, changes in water quantity or quality as a result of construction drainage, general construction disturbance (e.g. noise, vibration and light disturbance) and riparian habitat and vegetation loss.

7.8.132. Construction activities, such as excavation and material movements to accommodate new watercourse crossings, in addition to the spillage of fuels or other contaminating liquids may also impact the watercourses and ponds within the combined study area. However, as outlined within the embedded mitigation, best practice pollution prevention measures and silt management/control measures will be implemented throughout the construction period.

7.8.133. As such, impacts arising from pollution and siltation of aquatic habitats as a result of construction activities are considered to be appropriately mitigated to avoid or prevent adverse effects on aquatic resources.

Watercourses

7.8.134. Construction impacts to watercourses and associated species are detailed in Table 7-15~~Table 7-15~~. The watercourses listed are shown on Figure 7-12A in Technical Appendix 7.12 (~~application~~Application document TR010063 APP 6.15).

Table 7-15 - Watercourse C~~c~~onstruction I~~i~~mpact P~~p~~athways

Watercourse Name	Construction Impact Pathway	Level of I~~i~~mpact (with O~~o~~nly E~~e~~mbedded M~~m~~itigation)
River Chelt	A new 30 m long, 20.8 m wide (deck width) and 2.8 m high clear span crossing over the River Chelt (West Cheltenham Link Road River Chelt Bridge) will result in permanent localised channel shading and loss of riparian habitat associated with earthworks for the construction of the bridge. Shading caused by the deck will impact in-channel and riparian vegetation structure under the bridge, as well as potentially having localised minor adverse impacts on other species such as aquatic macroinvertebrates and fish through habitat quality reduction. Temporary noise and visual disturbance associated with the construction of the permanent and temporary bridges that will cross the River Chelt may act to deter fish passage and spawning activity of fish, including species such as lamprey and European eel. Abutments will be set back from the channel on both sides, by approximately 4 m, removing the requirement for any in-channel piers or other structures. However, due to an increased likelihood	Minor adverse

Watercourse Name	Construction Impact Pathway	Level of Iimpact (with Oonly Eembedded Mmitigation)
	of bank erosion (caused in part by shading acting to remove bankside vegetation) it is assumed that hard engineered bank protection will be required underneath the new bridge structure causing permanent modification and potential localised loss of marginal lamprey ammocoete habitat. The bank protection will prevent erosion and bank retreat that may otherwise undermine the new bridge abutments. At this stage, the details of the bank protection have not been determined but it has been assumed that the length will equal that of the width of the bridge deck and comprise of hard bank protection (e.g. rip-rap or non-biodegradable geotextile) as a worst case scenario. A bioengineered "green solution" would be used to transition from the grey bank protection to the natural banks up and downstream of the crossing. At the detailed design stage, further assessment and consultation with the Environment Agency will determine the most pragmatic solution and confirm the need for bank protection, to specify the materials and general arrangement which will endeavour to minimise and, where possible, exclude hard engineered bank protection. A temporary haul bridge will be constructed upstream of the new permanent structure to facilitate construction. The placement and use of the temporary haul bridge during construction may result in temporary disturbance to riparian habitats and temporary in-channel shading and as a result localised loss of aquatic plants and riparian vegetation. Additional temporary de-vegetation of the riparian zone is likely to be required to facilitate construction of the structure. Construction activities such as excavation, plant/material movements and piling to accommodate the new watercourse crossing may result in disturbance to aquatic species. Works to Drain 21, that is hydrologically connected to the River Chelt, may result in minor riparian habitat loss, whilst siltation and pollution will be managed through embedded mitigation. No change in the extent of the existing M5 River Chelt Culvert is required to facilitate road widening.	
Leigh Brook	The Leigh Brook Culvert under the M5 is to be extended from 53.52 m to 69.87 m to accommodate the installation of the two northern slip roads at SO 90758 26014, resulting in the permanent loss of 16.35 m of open channel and riparian habitat. Construction activities such as excavation and plant/material movements to accommodate the culvert extension and channel realignment, may result in temporary disturbance to aquatic species. However, species most likely to be sensitive to construction disturbance (namely noise, visual and light disturbance) are fish. The section of the Leigh Brook within and immediately adjacent to the Scheme does not support fish all year round due to poor habitat quality and intermittent flow. This limits the presence and number of key sensitive species, such as migratory eel, salmonids and brook/river lamprey. Some individuals of notable species and minor species such as stickleback may be present within the channel when flowing, but impacts from disturbance associated with works to the Leigh Brook are not expected to affect the overall populations of these species within the local area given the watercourse is only likely to support very small numbers.	Minor adverse

Watercourse Name	Construction Impact Pathway	Level of Iimpact (with Oonly Eembedded Mmitigation)
	It is expected that in-channel works to facilitate the extension of the Leigh Brook Culvert would take place when the channel is naturally dry. However, over pumping or fluming of the Leigh Brook may be required if the watercourse is flowing at the time of in-channel works. If this is the case, there will be a localised temporary loss of any in-channel aquatic macrophyte and aquatic macroinvertebrate species and potential for fish entrainment within the working area or equipment which could result in harm/mortality~~Construction activities such as excavation and plant/material movements to accommodate the culvert extension and channel realignment, may result in temporary disturbance to aquatic species. However, species most likely to be sensitive to construction disturbance (namely noise, visual and light disturbance) are fish. The section of the Leigh Brook within and immediately adjacent to the Scheme does not support a significant fish population, due to poor habitat quality and intermittent flow. As such, this will act to limit the presence of key sensitive species, such as migratory eel, salmonids and brook/river lamprey. Some minor species such as stickleback may be present but impacts from disturbance are not expected to affect these populations within the local area.~~ ~~Over pumping of the Leigh Brook is required to facilitate the extension of the Leigh Brook Culvert. This will result in localised temporary loss of any in-channel aquatic macrophyte and aquatic macroinvertebrate species~~. There will also be temporary bankside disturbance associated with the construction of a new drainage outfall (open cut channel) from an adjacent attenuation basin.	
MW3	Minor temporary loss of riparian vegetation may be required to facilitate construction of an attenuation basin and associated drainage outfall. No realignments or crossing structures are anticipated. Despite the potential for minor temporary habitat loss associated with construction works, the Scheme is not expected to result in any effect on the integrity or key characteristics of this resource within the combined study area. Moreover, it will not result in any measurable impact on the aquatic ecological function of the watercourse in the long term.	Negligible adverse
Drain 8	Required earthworks and extension of the existing culvert will result in the need for localised realignment of sections of this drain which is incorporated into the drainage strategy for the Scheme. Despite the temporary habitat loss associated with the realignment works, the Scheme is not expected to result in any effect on the integrity or key characteristics of this resource within the combined study area. Moreover, it will not result in any measurable impact on the aquatic ecological function of the watercourse in the long term.	Negligible adverse
Drain 9	Required earthworks will result in the need for localised realignment of sections of this drain as part of the drainage strategy. Despite the minor permanent habitat loss associated with a new culvert and temporary habitat loss associated with realignment works, the Scheme is not expected to result in any effect on the integrity or key characteristics of this resource within the combined study area. Nonetheless, minor permanent loss of habitat associated with a new culvert will result in a minor adverse effect in the long term.	Minor adverse

Watercourse Name	Construction Impact Pathway	Level of Iimpact (with Oonly Eembedded Mmitigation)
Drain 10	This watercourse is within the footprint of the Scheme and interacts with both widening of the M5 and A4019. Required earthworks and extension of existing culverts will result in the need for complete realignment of the drain which is incorporated into the drainage strategy for the Scheme. Additionally, approximately two new pipe culverts are required within the realigned channel to account for the Link Road and access track crossings. Despite the addition of two new culverts and the temporary habitat loss associated with realignment works, the Scheme is not expected to result in any effect on the integrity or key characteristics of this resource within the combined study area. Nonetheless, minor permanent loss of habitat associated with new culverts will result in a minor adverse effect in the long term.	Minor adverse
Drain 11	Required earthworks will result in the need for localised realignment of sections of this drain. Despite the temporary habitat loss associated with realignment works, the realignment which is incorporated into the drainage strategy for the Scheme is not expected to result in any effect on the integrity or key characteristics of this resource within the combined study area. Moreover, it will not result in any measurable impact on the aquatic ecological function of the watercourse in the long term.	Negligible adverse
Drain 12	Drain 12 will be crossed by a box culvert 2 m high, 6 m wide and 31.85 m long, which will result in permanent open channel and riparian habitat loss. The culvert invert will be set 300 mm below bed level and set perpendicular to the road. Construction activities such as excavation, plant/material movements and piling to accommodate the new watercourse crossing may result in temporary disturbance to aquatic habitats and species. However, the taxon most likely to be at risk from construction disturbance (namely noise, vibration and light disturbance) is fish. Drain 12 is not considered to have a significant fish population since the channel was observed to be dry. The ephemeral nature of the channel is likely to limit the presence of fish including key sensitive species, such as migratory eel, salmonids and brook/river lamprey. As such, disturbance impacts are considered to be negligible.	Minor adverse
Drain 14	There are no requirements for culvert extensions or realignments to Drain 14. However, due to its proximity to the Scheme, there are risks associated with riparian disturbance. With appropriate mitigation in place, it is assumed disturbance impacts will be negligible.	Negligible adverse
Drain 15	Required earthworks will result in the extension of the existing culvert and new flood culverts under the B4634 by resulting in permanent loss of open channel habitat. Construction activities such as excavation, plant/material movements and piling to accommodate the new watercourse crossing may result in temporary disturbance to aquatic habitats and species. However, the taxon most likely to be at risk from construction disturbance (namely noise, vibration and light disturbance) is fish. Drain 15 is not considered to have a significant fish population since the channel was observed to be dry. The ephemeral nature of the channel is likely to limit the presence of fish including key sensitive species, such as migratory eel,	Minor adverse

Watercourse Name	Construction Impact Pathway	Level of ~~I~~impact (with O~~o~~nly E~~e~~mbedded M~~m~~itigation)
	salmonids and brook/river lamprey. As such, disturbance impacts are considered to be negligible.	
Drain 16	Required earthworks will result in the need for localised realignment of sections of this drain which is incorporated into the drainage strategy for the Scheme. Despite the temporary habitat loss associated with realignment works, the Scheme is not expected to result in any effect on the integrity or key characteristics of this resource within the combined study area. Nonetheless, minor permanent loss of habitat associated with the new culvert will result in a minor adverse effect in the long term.	Minor adverse
Drain 20	Required earthworks will result in the need for localised realignment of sections of this drain which is incorporated into the drainage strategy for the Scheme. Despite the temporary habitat loss associated with realignment works, the Scheme is not expected to result in any effect on the integrity or key characteristics of this resource within the combined study area. Nonetheless, minor permanent loss of habitat associated with the new culvert will result in a minor adverse effect in the long term.	Minor adverse
Drain 21	This watercourse is to be regraded for continuity of flow and will receive a discharge from an attenuation basin. During construction, this will result in temporary habitat loss due to vegetation clearance; however, in the long term this regrading could be beneficial for the maintenance of flows and improved channel form. Construction effects have been assessed as no change on the overall condition.	No change
Drain 22	The Scheme will result in the extension of Piffs Elm Culvert from 47.54 m to 147.69 m at SO 90383 25494, resulting in a loss of open channel habitat of 100 m. Over-pumping will need to be undertaken to facilitate the Piffs Elm Culvert extension, which may result in localised loss of minor aquatic macrophyte and aquatic macroinvertebrate species. Drain 22 is an isolated ditch, thought to be taking drainage from the existing M5. As such, it is likely to be heavily modified and provide limited habitat for aquatic species. Nonetheless, the loss of open channel is considered to have a permanent adverse effect on the resource.	Major adverse

Standing waterbodies

7.8.135. No ponds are located under the footprint of the Scheme or within the Order limits. Taking into account the embedded mitigation, no construction impacts to standing waterbodies (ponds) have been identified.

Operational impacts

7.8.136. Potential operational impacts on aquatic resources are likely to arise from the operation of the Scheme drainage, resulting in water quality and quantity impacts, if appropriate attenuation and treatment of road run-off is not in place.

7.8.137. Embedded mitigation has been incorporated into the drainage strategy to allow for management of volumes and quality of any surface water run-off. The drainage strategy consists of six attenuation basins along the M5, A4019 and the West Cheltenham Link Road. Further details of the mitigation within the drainage strategy can be found in Chapter 8 - Road Drainage and Water Environment (~~application~~Application document ~~TR010063 – APP 6.6~~TR010063/APP/6.6).

7.8.138. The drainage design provides sufficient mitigation to ensure any change in water quality as a result of highways runoff will be compliant with Environmental Quality Standards based on the Highways England Water Risk Assessment Tool (HEWRAT).

Watercourses

7.8.139. Operational impacts to watercourses and associated species are detailed in Table 7-16~~Table 7-16~~.

Table 7-16 - Watercourse Ooperational Iimpact Ppathways

Watercourse Name	Operational Impact Pathway	Level of Iimpact (with Oonly Eembedded Mmitigation)
River Chelt	Minor changes to out of bank flood flow behaviour and interchange of water between the River Chelt and the Leigh Brook during flood events may result from works to the A4019 and creation of the flood storage area. However, this will have a negligible effect on channel flow velocities that are important for the maintenance of in-channel habitat structure and stream ecology. The River Chelt is the receiving watercourse from the A4019 main line at Elms Park drainage catchment and the S1 drainage catchment. Changes in water quality associated with the Scheme drainage design will not occur given the HEWRAT routine runoff assessment passes for all surface water tests. There will be no changes in water quantity, beyond those outlined above during flood events, as the drainage design incorporates suitable attenuation to greenfield runoff rates.	Negligible adverse
Leigh Brook	Minor changes to out of bank flood flow behaviour and interchange of water between the River Chelt and the Leigh Brook during flood events may result from works to the A4019 and creation of the flood storage area. However, this is expected to have a negligible effect on channel flow velocities that are important for the maintenance of in-channel habitat structure and stream ecology. The Leigh Brook will have a new drainage outfall (open cut channel) from an adjacent attenuation basin within the S2 drainage catchment. Changes in water quality associated with the Scheme drainage design will not occur given the HEWRAT routine runoff assessment passes for all surface water tests. Drain 10 will no longer discharge to the Leigh Brook upstream from the Leigh Brook Culvert, therefore, there will be changes associated with hydromorphology, e.g. changes in water quantity, received by the Leigh Brook in this location.	Minor adverse
MW3	MW3 sits within the S1 drainage catchment. There will be no changes in water quality associated with the Scheme drainage design given the HEWRAT routine runoff assessment passes for all surface water tests. There will be no changes in water quantity, as the drainage design will incorporate suitable attenuation to greenfield runoff rates.	No change
Drain 8	Drain 8 sits within the J1 drainage catchment. There will be no changes in water quality associated with the Scheme drainage design given the HEWRAT routine runoff assessment passes for all surface water tests. There will be no changes in water quantity, as the drainage design will incorporate suitable attenuation to greenfield runoff rates.	No change
Drain 10	Drain 10 sits within the combined pond drainage catchment. The drainage design may result in permanent changes in water quality	Minor adverse

Watercourse Name	Operational Impact Pathway	Level of Iimpact (with Oonly Eembedded Mmitigation)
	within this feature in the absence of mitigation. There will be no changes in water quantity, as the drainage design will incorporate suitable attenuation to greenfield runoff rates.	
Drain 11	Drain 11 is expected to have a new drainage outfall from an adjacent attenuation basin and sits within the combined pond drainage catchment. The drainage design may result in permanent changes in water quality within this feature in the absence of mitigation. There will be no changes in water quantity, as the drainage design will incorporate suitable attenuation to greenfield runoff rates.	Minor adverse
Drain 15	Drain 15 is expected to have a new drainage outfall from an adjacent attenuation basin in the Link Road drainage catchment. Changes in water quality associated with the Scheme drainage design are not anticipated to occur given the HEWRAT routine runoff assessment passes for all surface water tests. There will be no changes in water quantity, as the drainage design will incorporate suitable attenuation to greenfield runoff rates.	No change
Drain 21	Drain 21 is expected to have a new drainage outfall from an adjacent attenuation basin (receiving drainage from the A4019 main line at Elms Park drainage catchment). Changes in water quality associated with the Scheme drainage design are not anticipated to occur given the HEWRAT routine runoff assessment passes for all surface water tests. There will be no changes in water quantity, as the drainage design will incorporate suitable attenuation to greenfield runoff rates.	No change
Drain 9, Drain 12, Drain 14, Drain 16, Drain 20, and Drain 22	No operational effects identified.	No change

Standing waterbodies

7.8.140. No ponds are located under the footprint of the Scheme or within the Order limits. Moreover, no existing ponds are incorporated into the drainage strategy and as such are not expected to experience any changes in water quality or quantity. Taking into account the embedded mitigation, no operational impacts to standing waterbodies (ponds) have been identified.

Additional mitigation measures

7.8.141. In addition to the embedded measures set out above, there are additional, essential mitigation measures[156] which will be implemented to mitigate or offset potential impacts for specific biodiversity resources. These measures are described for the relevant resources in the subsections below, along with measures to ensure legal compliance with regard to badger and Himalayan balsam. In addition, enhancement measures are also discussed.

7.8.142. The essential mitigation measures are included within the REAC (~~application~~Application document ~~TR010063-APP-7.4~~TR010063/APP/7.4).

[156]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.

Designated sites

7.8.143. To mitigate the potential for disturbance/injury/mortality to migratory fish species associated with the Severn Estuary SAC/Ramsar Site (European eel sea trout and Atlantic salmon associated with the Severn Estuary Ramsar Site and river lamprey associated with the Severn Estuary SAC and Ramsar Site) that are potentially using functionally linked habitat within the River Chelt, the following measures will be put in place and overseen by a suitably qualified and experienced ECoW:

- All haul roads, lay down areas and compounds will be located at least 10 m[157] from watercourses, except where access is required to specific locations for works to bridges/culverts for example. Site tracking routes will be arranged to avoid watercourse margins to limit disturbance to watercourse, riparian and bankside habitats and fish species.
- Soft start procedures will be implemented to gradually increase the sound/vibration intensity over a period of time. The aim is to gradually habituate migratory fish to increased noise/vibration or temporarily deter migratory fish before the full volume/vibration intensity is reached so that noise exposure is reduced. Soft start up methods will be employed on plant being used for any in-channel works and works within 20 m of the River Chelt, including piling, at the start of each working day to ensure sudden disturbance to fish and other wildlife is minimised as far as practically possible. The soft-start duration should be a period of not less than 20 minutes and should piling cease for a period greater than 20 minutes, the soft start procedure must be repeated.
- Ten piles will be rotary drilled on each side of the River Chelt. Rotary piling results in less noise and vibration than percussive piling.
- Prior to any in-channel works or de-watering, measures shall be implemented that act to temporarily displace fish from the working area. Measures may include the removal of channel features from the working area that provide cover such as large wood to reduce the overall attractiveness of the working area for fish species. This is particularly relevant to benthic species such as European eel that frequently occupy voids between larger substrates. Such in channel features that provide cover will be replaced after the construction works.
- In the event that dewatering is required during the installation of bank protection, only part of the width of the channel will be dewatered. Therefore, continuity of flow and fish passage would be maintained at all times during construction. A fish rescue plan will be developed in consultation with the Environment Agency and Natural England, which may include the need to relocate lamprey ammocoetes prior to dewatering in order to reduce the potential for injury/mortality. The fish rescue plan will also include a requirement for an ecological watching brief.
- Appropriate screening of any pumping equipment during dewatering activities will be implemented (2 mm screens) to avoid any potential entrainment/mortality of fish during the works.
- Consider the use of temporary stop nets across the channel upstream of the works to prevent fish from becoming entrained in the working area.
- Where possible, works most likely to cause disturbance to migratory species in the River Chelt (i.e., the construction of the new bridge crossing and installation of bank protection associated with the crossing) will be timed to occur outside of the key ecologically sensitive periods for migratory fish species. Due to the range of species potentially present, it may not be practical to avoid all sensitive periods. However, based on the fisheries habitat provision at the crossing and confirmed species presence the migratory and/or spawning periods for European eel, river lamprey and sea/brown trout will be the focus of the timing consideration. February to July

[157] 10 m is used here and in subsequent paragraphs as this is the distance over which vibration from percussive piling will have attenuated to below the particle motion disturbance threshold for European eel of 13mm/s. Percussive piling is the construction activity that is likely to cause most vibration (and in fact the Scheme will actually use rotary piling). Taking a precautionary approach, it is assumed that construction works within 10 m of the River Chelt could potentially cause disturbance to fish, and mitigation measures for works within this zone have been implemented.

and October to November will be avoided as far as possible, as they are the key migratory periods for European eel[158], which also avoids the spawning period for lamprey (March to April[159]), sea trout and Atlantic salmon (peaks in October to November). These periods will be confirmed through ongoing consultation with Natural England and the Environment Agency.

- Where works during migratory periods are unavoidable, no night-time (taken to be between 30 minutes prior to sunset until 30 minutes following sunrise) vibration work will be undertaken. If night working is essential, minimal and directional lighting will be used.

Terrestrial habitats

7.8.144. 22.56 ha of species rich road verge will be created within the Order limits, which will more than compensate for the loss of approximately 0.1 ha of lowland meadow priority habitat along the A4019. A Road Verge Compensation Strategy will be designed and agreed with statutory consultees during detailed design, but a high-level approach is provided below. Natural England have confirmed that they are in agreement with the broad proposals.

7.8.145. The approach to habitat creation will be to match the species composition and community type of a proportion of newly created species rich grassland habitat to that which will be lost.

7.8.146. The approach to habitat creation will be refined during detailed design, but seed / green hay will be sourced from an appropriate local donor site (potentially through the Glorious Cotswold Grasslands initiative run by the Cotswolds ~~AONB~~National Landscape). Consideration will also be given to habitat translocation, where feasible.

7.8.147. These areas of species-rich road verge (once created) will require annual maintenance at an appropriate time of year (late July to end of September) and all arisings must be collected and taken off site. This is in line with Gloucestershire Highways and Biodiversity Guidance[16].

7.8.148. Targets will be set to monitor against, focusing on target species and condition criteria in line with the habitat condition assessment as set out within the Biodiversity Metric 3.0 Technical Supplement[83]. These will be agreed with the relevant consultees, in addition to the method of monitoring and frequency of monitoring, during detailed design.

Bats

7.8.149. In addition to the embedded mitigation measures described previously (including the habitat creation measures, installation of two compensatory bat roost structures, the Withybridge (A4019) underpass, the clear span bridge structure over the River Chelt, lighting measures and hop over planting), the following additional essential mitigation measures for bats are required:

- Protection of retained roosts through localised implementation of sensitive timing of works and acoustic barriers to reduce disturbance.
- Works which would impact on known or assumed bat roosts will be carried out under a Natural England European Protected Species (EPS) mitigation licence.
- Pre-construction surveys prior to any tree clearance and demolition of buildings. Surveys may need to be updated to ensure that any new roosts are identified, and that the current status of roosts are understood, and surveys will also be required where access has prevented surveys being undertaken to-date. If any new roosts are identified these would need to be included in the Natural England EPS mitigation licence.

[158] https://www.fishsec.org/2020/05/15/eel-migration-report-provides-insights-but-also-highlights-data-gaps/
[159] Maitland, P. (2003) Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000, Ecology Series No.5. English Nature, Peterborough.

- Works under a Natural England EPS mitigation licence for bats will require presence of an appropriately licenced ecologist during the works in accordance with the method statement agreed with Natural England.
- Demolition of structures or felling of trees with features suitable to support roosting bats, but where surveys have not confirmed the presence of bats, will be completed under precautionary working methods under guidance from an appropriately licenced ecologist.
- Provision of alternative roost habitat in the form of small structures for crevice dwelling bats, night roost features suitable for lesser horseshoe bats, bat boxes and tree features, with a dark corridor maintained around such features. These are listed below. However, as explained in paragraph 7.4.38, the emerging 2023 survey work is confirming that a precautionary approach has been taken with regard to the predicted bat roost resource and predicted impacts. On completion of the pre-construction surveys, the following measures may be ~~reduced, in~~reduced, in consultation with Natural England and subject to approval under a Mitigation Licence:
    - Northern quadrant – Three crevice dwelling bat roost structures, five artificial bat boxes for crevice dwelling species, one artificial maternity bat box, one tree roosting feature.
    - Eastern quadrant – two horseshoe night roosts, three hibernation bat boxes, one tree roosting feature.
    - Southern quadrant – three horseshoe night roosts, two crevice dwelling bat roost structures, five hibernation bat boxes, one artificial maternity bat box.
    - Western quadrant – One artificial bat box for crevice dwelling species, two tree roosting features.
- Measures to avoid/reduce impacts of habitat fragmentation through temporary installation of Heras fencing or dead hedging to protect flight lines when key commuting route vegetation is cleared.

7.8.150. All of the bat mitigation measures, including embedded and additional measures, are detailed in Technical Appendix 7.15 - Bat Mitigation Strategy (~~application~~Application document ~~TR010063 - APP 6.15~~TR010063/APP/6.15).

Dormouse

7.8.151. All clearance of habitat suitable for supporting dormice to the north of the A4019 and east of the M5 will be carried out under a Natural England EPS mitigation licence for dormouse. Natural England have reviewed a draft dormouse licence for the Scheme and have issued a LoNI in respect of dormice. The LoNI is included with the DCO application. Clearance of the most suitable habitat within the remainder of the Scheme, including the blocks of woodland and more extensive areas of scrub around the junction, will be carried under a precautionary method of working (PMW).

7.8.152. Vegetation clearance will be undertaken using a two-stage approach. The first stage of clearance is between November and March (inclusive) and involves removing suitable woody vegetation to no lower than 300 mm above ground level, to encourage dormice emerging from hibernation in April or May to move to more appropriate habitat nearby. Clearance will be done by hand and in a sensitive manner to minimise the likelihood of harming dormice hibernating at ground level. All vegetation to be cleared with suitability for dormice will first be searched by hand by a licensed ecologist. Arisings from the first stage of the habitat clearance will be used to create dead hedging. These dead hedges will run either parallel or perpendicular from the cleared hedgerows to areas of retained suitable dormouse habitat to maintain connectivity and allow any hibernating dormice to disperse away from the Scheme when they emerge from hibernation in spring. The second stage of vegetation clearance will be undertaken in April/May and will involve removal of vegetation to ground level, following a hand search by a licensed ecologist. The methods and timing of vegetation clearance will be set out in the PMW, and in the licence method statement.

7.8.153. A number of existing hedgerows will be enhanced for dormice. This is presented in the Environmental Masterplan (~~application~~Application document ~~TR010063 - APP 2.13~~TR010063/APP/2.13), with specific hedgerow numbers shown in Figure 7-2A in Technical Appendix 7.2 – Hedgerow Survey (~~application~~Application document ~~TR010063 - APP 6.15~~TR010063/APP/6.15). Measures include:

- H199, H199a, H200, H201, H205 and H206 are intensively managed hedgerows. As these hedgerows are being retained and are hedges which are potential natural dispersal routes, dormice will benefit from reducing the management intensity to being cut no more than once every three years, with their height kept at no less than 3 m. In addition, the number of native woody species present in hedgerows H199, H199a and H200 will be increased to seven through localised coppicing and planting.
- H48 is a species-rich hedgerow with trees which leads north away from the Scheme Boundary and is linked to retained suitable habitat. However, there are gaps in the hedge totalling approximately 35 m, and therefore the planting of these gaps with a mixture of valuable species to dormice, especially hazel, pedunculate oak, and honeysuckle, which are currently absent, will increase connectivity and food availability to dormice.
- H201 is over managed and has gaps totalling approximately 80 m. Therefore, the planting of these gaps with a mixture of valuable species to dormice, such as hazel, pedunculate oak, honeysuckle, bramble, sallow and hawthorn, will increase the suitability of the hedgerow to dormice.
- HT18 is currently a line of poplar sp. trees, with a bramble, elder and hawthorn understorey. This linear feature will be enhanced by planting species of benefit to dormice such as hazel, pedunculate oak, and honeysuckle to create a dense understorey of plants that will provide food and nesting resources for dormice.

7.8.154. Additional habitat for dormice will also be created. This is presented in the Environmental Masterplan (~~application~~Application document ~~TR010063 - APP 2.13~~TR010063/APP/2.13), with specific hedgerow numbers shown in Figure 7-2A in Technical Appendix 7.2 – Hedgerow Survey (~~application~~Application document ~~TR010063 - APP 6.15~~TR010063/APP/6.15). Measures include:

- New hedgerows will be planted parallel to the north of the A4019 and a new hedgerow is proposed from H205 to H207, south to north, perpendicular to the A4019. New hedgerows will be planted with a mixture of species including those of value to dormice such as hazel, pedunculate oak, honeysuckle, bramble, sallow, blackthorn and hawthorn. Planting will take place between early November and March using 60-90 cm whips with biodegradable tree guards, in a double row at a spacing of 20-30 cm.
- New scrub will be planted on the M5 southbound soft estate, north of Junction 10. This will include a mixture of species including hazel, hawthorn, blackthorn, honeysuckle and bramble, all of which are of value to dormice. Planting will take place between early November and late March using 60-90 cm whips with biodegradable tree guards and planted in clumps with unplanted gaps to create open ground as part of the mosaic.
- New woodland will be planted on the M5 southbound soft estate, north of Junction 10, and along the A4019 soft estate eastbound near to Junction 10. This will be planted with a mixture of species; field maple, hornbeam, hazel, hawthorn, holly, crab apple, blackthorn, dog rose, elder and guelder rose. Planting will take place between early November and late March using 60-90 cm whips with biodegradable tree guards, spaced 2.5 m apart.
- Nest boxes will be installed in H48, HT18, H88 and H+WD2 (approximately five in each hedgerow) during the hibernation period when the first stage of the two-stage vegetation clearance is commencing. These will provide immediate resting and nesting oppourtunites for dormice as new planting develops and once dormice emerge from hibernation.

7.8.155. The habitat enhancement and creation of the new hedgerow perpendicular to the A4019 will be undertaken as advance works.

7.8.156. Habitats for dormice will be managed and maintained as described in the following paragraphs.

7.8.157. Hedgerows will be managed for 10 years following completion of the enhancement works as follows:

- Hedgerows to be retained and enhanced will be managed less intensively, being trimmed every three years on rotation, with a minimum height of 3 m maintained.
- Newly planted hedgerows will be cut in an 'A' shape to maintain a wide base.
- Weeding and annual top up of mulch within 0.5 m radius of each whip to 50 mm depth.

7.8.158. Woodland will be managed for 15 years following completion of planting as follows:

- Maintain a weed free zone of 0.5 m radius around the base of each plant.
- Poorly performing or dead specimens will be removed.
- Annual top up of mulch within 0.5 m radius of each whip to 50 mm depth.
- Infill planting/gapping up, as appropriate.
- Annual pruning, appropriate to species.

7.8.159. Scrub will be managed for 10 years following completion of planting as follows:

- Maintain a weed free zone of 0.5 m radius around the base of each plant.
- Poorly performing or dead specimens will be removed.
- Annual top up of mulch within 0.5 m radius of each whip to 50 mm depth.

7.8.160. Protective fencing and guards will be checked annually and repaired or replaced as required. This will be undertaken until planting is established, anticipated to be five years. Replacement specimens will be planted as appropriate in early November to late March for 10 years following the planting.

7.8.161. Post-construction monitoring of the dormouse population will be undertaken in accordance with the Method Statement that will form part of the final licence application, which will be agreed with Natural England. This will include three nest box monitoring visits each monitoring year in February/March (to clean and repair or replace dormouse nest boxes), in May/June (pre-breeding) and September/October (post-breeding), for a period of five years following completion of development within the dormouse licence area.

Badger

7.8.162. Seven badger setts are located within the Order limits and will be destroyed as a result of the Scheme as shown on Figure 7-5A in confidential Technical Appendix 7.5 – Badger Survey (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15):

- One main sett (sett 12a) and its associated annexe sett (sett 12b).
- One subsidiary sett (sett 13a) and two subsidiary setts (sett 6 & sett 6a) that have the capacity to become a main sett.
- A main sett (sett 7) and an outlier sett (7b) that could be linked to setts 6, 6a & 7.

7.8.163. All of these setts require closing under a Natural England licence. Natural England have reviewed a draft badger licence for the Scheme and have issued a LoNI in respect of badgers. The LoNI is included with the DCO application. An outlier (sett 7c) will be protected and any new setts that can be retained would also be protected.

7.8.164. Closure of the two main setts (Sett 7 and Sett 12a) will require compensation by creation of two replacement artificial setts. Closure of five other setts (setts 13a, 12b, 6a, 6 and 7b) that are not main setts do not require artificial sett creation.

7.8.165. The artificial setts will be located within 100 m of the current setts, where there is access to existing foraging habitat, as shown on Figure 7-5A in confidential Technical Appendix 7.5 – Badger Survey (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15. The standard recommendation for artificial sett size/scale is a four entrance and eight chamber sett which is more than sufficient for a main sett replacement and the footprint does not need to exceed 7 m by 15 m. 'Blind ending' tunnels will be provided where appropriate in order to allow for expansion of the sett, these will be directed away from the Scheme areas. Both artificial setts will be planted with a meadow mix and scrub to provide suitable habitat and cover for badgers. The setts will be constructed with naturally-shaped off-set chambers, and plastic pipe cut to create kinks and turns. They will be constructed at ground level or on a pad of soil to minimise flooding risk.

7.8.166. 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.

7.8.167. The proposed process of sett exclusion and closure is as follows, subject to Natural England agreement:

- Closure will be planned for between 1 July to 30 November (outside of badger breeding season).
- At least four weeks prior to the start of the exclusion, the area over and across the setts will be strimmed of vegetation, to ensure all the entrances have been located. All of the entrances will be monitored for evidence of badger activity to confirm use/disuse. This will be achieved using sticks placed vertically in front of the entrances, or by placing a plug of loose hay in the entrance, and by loosening the soil on the spoil heaps. Motion sensor cameras may also be used to aid the monitoring of activity at the setts.
- On receipt of a licence from Natural England, one-way badger gates will be fitted to all entrances showing evidence of use by badgers. Entrances that have been shown to be disused throughout the four weeks prior to the exclusion will be hard stopped.
- The area around the one-way gates and across all hard-stopped entrances will be proofed with 2.5 mm gauge medium stock netting (C8/80/15) extending to at least 5 m radius around all the sett entrances. The netting will be laid on the ground and tightly moulded to the contours of the sett and attached to wooden pegs and metal J pegs driven firmly into the ground, to deter badgers from digging back into the sett.
- The one-way gates will remain in place for a minimum period of 21 days and will be checked every three days to ensure badgers have not re-entered the sett or breached the netting. The use of the gates will be monitored using small sticks placed in front of the gates and sticks placed at arm's length down the tunnels will be used to monitor for badgers remaining inside the sett. Motion sensor cameras will be used to monitor badger activity around the setts.
- Following 21 days with no evidence of badgers entering the setts, the gates will be secured (prevented from opening in either direction) or removed and the entrances hard stopped, under the direction of the licence holder or an accredited agent.

7.8.168. The setts will then be destroyed to their full extent using a mechanical digger or excavator, under the direction of the named ecologist or an accredited agent, as soon as possible after completion of exclusion. All conditions of the Natural England licence will be adhered to during the closure of the sett.

7.8.169. Badger-proof fencing, combined with wildlife crossing points described in the embedded mitigation section will ensure continued habitat connectivity for badgers and prevent badger access onto the carriageway.

7.8.170. Given the potential for new setts to be excavated in a short space of time, pre-construction surveys will be undertaken to ensure the current baseline information is kept fully up to date. Pre-construction surveys are proposed ahead of sett closures, prior to the start of construction, preferably six months ahead of any works being carried out.

7.8.171. Site staff and contractors will be given a pre-works toolbox talk by an ECoW prior to works which discusses ecological constraints. As badgers can excavate setts at any time of year, regular checks will be made by the ECoW prior to and during construction to record any new setts and to determine the appropriate course of action.

7.8.172. Any non-licensed works that encroach within 30 m of a sett will be assessed by a competent ecologist to ensure disturbance is minimised. Exclusion zones will be marked out around setts to ensure works do not encroach. This will be the case for sett 7c.

Otter

7.8.173. None of the identified resting sites will be permanently lost as a result of the Scheme. However, there is considered to be the potential for disturbance to otter resting sites where these lie within 250 m of the Scheme. Further monitoring surveys will be undertaken prior to the start of works to ascertain the current status of these resting sites. Noise and vibration will be minimised within a 250 m buffer of any active otter resting sites. In addition, night-time working will be avoided where possible within this buffer (no work between sunset and sunrise).

7.8.174. In-channel works will be avoided where possible, and potential otter commuting routes within suitable habitats (River Chelt, Leigh Brook, MW4) including existing underpass structures beneath the M5 will remain open and unblocked to avoid forcing otters to cross over the M5 carriageway instead.

7.8.175. All haul roads, lay down areas and compounds will be located at least 10 m from watercourses used by otter, except where access is required to specific locations for works to bridges/culverts for example.

Breeding and wintering birds

7.8.176. In order to avoid destruction of active bird nests, clearance of suitable bird nesting habitat will be undertaken outside of the main bird nesting season (generally March to August inclusive in southern England) as far as possible. Any clearance during the nesting period will 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 will be established around the nest and clearance activities delayed within that zone until the nesting attempt has reached its natural conclusion.

7.8.177. In order to prevent disturbance of nesting Schedule 1 bird species (e.g. barn owl and kingfisher), it may be necessary to restrict construction activities in the vicinity of Schedule 1 bird nests while they are active. Pre-construction breeding surveys will be undertaken during the relevant breeding seasons to determine the exact location of any nesting Schedule 1 species.

7.8.178. Bird boxes will be erected to compensate for the loss of territory suitable for priority hole-nesting species. The precise location will be agreed during detailed design, but will include a minimum of ten nest boxes suitable for displaced hole-nesting species and at least one nest box specifically designed for tawny owl (such as that provided by Schwegler or the RSPB) erected in retained woodland at a height of approximately 4 m; and one grey wagtail box, which will be attached to the underside of a bridge on the River Chelt.

7.8.179. The loss of breeding habitat for non-hole-nesting species, e.g. dunnock, linnet, reed bunting and song thrush, will be mitigated for in the long term by the landscape planting which includes woodland and native species-rich hedgerows with trees.

7.8.180. In addition, night-time working will be avoided where possible (no work between sunset and sunrise).

7.8.181. Enhancements for hole-nesting species of birds in the form of additional nest boxes will be provided on retained mature trees, ideally situated at least 50 m from the construction footprint, and preferably prior to the commencement of any works. The precise location and number of boxes to be provided will be agreed during detailed design, but all boxes will be located on suitable trees between 2 m and 4 m from ground level. The boxes will comprise 20 open-fronted and hole nest boxes made of 'woodcrete' and 'woodstone' and suitable for a range of species associated with woodland and residential areas, such as 1SP Schwegler Sparrow Terrace, 3S Schwegler Starling Nest Box, 1B Schwegler Nest Box and Barcelona Open Nest Box for example.

7.8.182. Birds frequently occupy bat boxes, but this can be reduced by the installation of bird boxes close to bat boxes to reduce competition. Therefore, for each bat box installed, an equivalent number of bird boxes will be installed at the same location, where feasible. These boxes are in addition to those listed above.

Barn owl

7.8.183. Where possible, works will be undertaken outside of the core barn owl nesting period (generally March to August inclusive).

7.8.184. Pre-construction surveys within 48 hours of any work to be undertaken within 150 m of potential nest sites will be undertaken to confirm the status of the feature.

7.8.185. If an occupied nest site is confirmed within 150 m of the works, an ECoW will provide advice regarding specific mitigation, such as buffer zones or temporary screening to mitigate potential disturbance.

7.8.186. As an enhancement for barn owl, four barn owl boxes will be installed outside of 1.5 km of the Scheme Boundary (and 1.5 km from any major road) in locations selected following appropriate guidance[160].

Reptiles

7.8.187. Habitat creation will include the provision of natural refugia / habitat piles within retained and newly created habitat areas. The created reptile habitat features will be provided in advance of commencement of construction works, during vegetation clearance, to allow reptiles to be displaced into suitable established habitat.

7.8.188. Vegetation clearance will take place under a PMW with guidance from an ECoW, using a two-stage cut to encourage reptiles away from the working area.

Great crested newt

7.8.189. All clearance of great crested newt habitat will be carried out under the District Level Licensing Scheme for great crested newt, which is run by Naturespace in Gloucestershire.

7.8.190. This Scheme can be used by developers, for a fee, and focuses on landscape scale compensation for great crested newts, reducing on-site mitigation and compensation measures to a certain extent. Nevertheless, measures will be implemented to avoid the incidental killing or injuring of great crested newts, as directed by the licenced site ecologist. Such measures will include a toolbox talk, habitat manipulation, hand and destructive searches. Habitat manipulation, hand and destructive searches will proceed as follows:

- Immediately prior to works starting on Site, all suitable habitats within the working area that are located within 500 m of a waterbody where the presence of great crested newts have been confirmed will be checked by the ECoW for the presence

[160] Such as The Barn Owl Trust (2012) Barn Owl Conservation Handbook. Pelagic Publishing, Exeter.

of great crested newts. Work will not be permitted to start at the site until hand searching of the working areas has been completed.

- Any piles of wood, brash and rubble within the working area will be dismantled by hand and immediately removed from the working area, with the ECoW on-hand to provide advice, in advance of the works and ideally not during the winter hibernating period for great crested newts (November to February). Where it is not essential to remove potential refuges in order to undertake the works, these will be left undisturbed.
- Hand searching will include carefully checking within and underneath any potentially suitable refuges such as leaf piles around logs, tree trunks, bush stems and within coppice stools.
- Vegetation will be strimmed/cut by the Contractor, with the ECoW on-hand to provide advice, to approximately 150 mm height and all debris removed from the site using hand tools (i.e. rakes and wheelbarrows) to prevent use by great crested newts. Following this initial cut, the area will be checked for the presence of great crested newts by the ECoW.
- A further vegetation cut will be carried out following the initial cut to reduce the vegetation to ground level and litter removed as above. Vegetation will be maintained at a height of less than 50 mm throughout the course of the works.

7.8.191. Unwanted logs from vegetation clearance and stones from ground works will be used to create piles close to existing ponds or newly created waterbodies, which comprise six attenuation basins as well as wetland areas within the flood storage area. Split logs, dead wood, rocks and bricks, loosely filled with topsoil on a gentle slope provide a good refuge and hibernaculum for great crested newts. Careful consideration of placement and design to maximise use and prevent possible flooding, drying out and aesthetic complaints from the public will be necessary.

7.8.192. These mitigation measures will also have benefits for other species of amphibian, such as common toad.

Himalayan Balsam

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

7.8.194. 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.

7.8.195. A pre-construction INNS survey will 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 will 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 and species

7.8.196. The assessment has assumed a requirement for a hard engineered bank reinforcement protection (i.e. rip-rap) on the River Chelt under the proposed clear span bridge to manage erosion risks. However, at the detailed design stage, further assessment (including a scour assessment) will determine the most pragmatic solution and confirm the need for bank protection, specify the materials and general arrangement, which will endeavour to minimise and, where possible, exclude hard bank protection. Where this is not possible, further measures to mitigate for this will be explored, such as naturalised toe frontages comprising wood etc. The preferred approach will be agreed with the Environment Agency through consultation.

7.8.197. Where possible, in-channel works within the River Chelt (to facilitate the new bridge crossing and installation of bank protection) and the Leigh Brook (to facilitate the culvert extension and channel realignment) will avoid ecologically sensitive periods for fish species, e.g. migratory/spawning periods.

~~7.8.196.~~7.8.198. Should sections of the River Chelt or Leigh Brook channels require dewatering to facilitate the works, then a fish rescue plan will be developed in consultation with the Environment Agency. The fish rescue plan will include a requirement for an ecological watching brief and will detail the measures to be put in place to ensure protection of all fish species during in-channel works within both watercourses. The fish rescue plan shall include details of any licence requirements to permit fish rescues (e.g., FR2: Application for authorisation to use fishing instruments other than rod and line in England), as well as the requirement for appropriate screening of any pumping equipment (typically 2 mm screens) to avoid potential entrainment/mortality of fish during the works. Additionally, the fish rescue plan will consider the use of temporary stop nets across the channel upstream of the works to prevent fish from becoming entrained in the working area and measures to displace fish from the working area prior to construction works (see paragraph 7.8.143 for further details).

7.9. Residual effects

7.9.1. Table 7-17 below provides an assessment of the construction and operational impacts and subsequent effects of the Scheme on important biodiversity resources. The assessment takes account of all mitigation measures to be included in the Scheme.

Table 7-17 - Summary of ~~l~~impacts and E~~e~~ffects from C~~c~~onstruction and O~~o~~peration of the Scheme

Biodiversity R~~r~~esource	Value	Summary of ~~l~~impacts	Mitigation (including E~~e~~mbedded M~~m~~itigation and E~~e~~ssential M~~m~~itigation)~~.~~	Residual E~~e~~ffect (with E~~e~~mbedded and E~~e~~ssential M~~m~~itigation) (Refer to Table ~~7-2Table 7-2~~)	Significance C~~c~~ategory (~~r~~Refer to Table 7-3)
Severn Estuary SAC/Ramsar Site	International	Construction: Impacts to functionally linked habitat for migratory fish within the River Chelt as a result of: temporary reduction in the extent of functionally linked habitat and injury or mortality to river lamprey ammocoetes in the event that dewatering part of the river channel is required; a pollution event during construction, and consequent detrimental effects to qualifying migratory fish species; potential disturbance impacts to migratory fish using functionally linked habitat within the River Chelt; fragmentation as a result of disturbance and pollution.	Works will proceed following standard good practice working methods for environmental protection, including pollution prevention measures. Haul roads, lay down areas and compounds will be located at least 10 m from watercourses. Soft start procedures will be implemented for works within 20 m of the River Chelt and start up and run down of plant will be undertaken at least 20 m from the watercourse. Rotary piling will be used instead of percussive piling. If dewatering is required, only part of the channel will be impacted thereby maintaining fish passage. Prior to any in channel works or dewatering, measures will be taken to displace fish from the working area and a fish rescue plan will be developed with the Environment Agency and Natural England. Appropriate screening of any pumping	No change	Neutral

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-3)	Significance Ccategory (rRefer to Table 7-3)
			equipment will be implemented. Wherever possible, works will be timed outside the key ecologically sensitive periods for European eel, Atlantic salmon, sea trout and river lamprey. No night-time vibration work will occur during migratory periods. If night working is essential, minimal and directional lighting will be used. Ecologically sensitive design of structures such as culverts will be incorporated into the Scheme, to maintain connectivity, continuity of flow, and natural substrate establishment.		
		Operation: Impacts to functionally linked habitat for migratory fish within the River Chelt as a result of a pollution event during operation, and consequent detrimental effects to qualifying species.	The drainage strategy to be implemented by the Scheme incorporates SuDS to mitigate the pollution risk associated with road runoff as well as accidental spills.	No change	Neutral

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-3)	Significance Ccategory (rRefer to Table 7-3)
Terrestrial habitat – unimproved neutral grassland / lowland meadow priority habitat	County	Construction: Habitat loss of 0.1 ha and potential for habitat degradation as a result of air and water pollution.	Existing vegetation will be retained as far as possible. Works will proceed following standard good practice working methods for environmental protection. An appropriate control/eradication strategy will be in place to ensure that the spread of INNS is avoided. Creation of 22.56 ha of species rich road verge will compensate for the loss of 0.1 ha of lowland meadow.	Minor adverse as a result of small scale permanent habitat loss. Once newly created habitats are established, there will be an overall increase in the total area of this habitat type, resulting in long term benefits. While long term benefits of habitat creation will exceed the habitat loss, there will be a loss of existing habitat so both adverse and beneficial impacts are reported as minor on a precautionary basis. Overall, the significance of effects is reported as neutral (rather than slight beneficial) on this precautionary basis.	Neutral
		Operation: Habitat degradation as a result of air and water pollution.	The drainage strategy to be implemented by the Scheme incorporates SuDS to mitigate the pollution risk associated with road runoff as well as accidental spills. The Scheme will result in small increases in NOx levels and nitrogen deposition in localised areas adjacent to the highway as a result of predicted traffic increases (it should be noted that this	Minor adverse as a result of small scale, localised air quality effects. Overall the significance of effects is reported as slight (rather than neutral) on a precautionary basis.	Slight

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-2)	Significance Ccategory (rRefer to Table 7-3)
			habitat type does not require detailed air quality assessment as per LA 105). However, significant effects are not anticipated, given the small-scale changes anticipated in localised areas, and considering that surveys have shown that a range of habitat types have established and persisted adjacent to the busy M5 and A4019 corridors. Furthermore, habitat management, particularly removal of arisings following grassland cutting, will mitigate any adverse impacts.		
Terrestrial habitat – Stanboro Lane orchard habitat complex and potentially present noble chafer population	County	Construction: Habitat loss and potential for habitat degradation as a result of air and water pollution. The traditional orchard within this habitat complex will not be lost, and therefore no impacts to this habitat, or noble chafer, if present, are anticipated.	Existing vegetation will be retained as far as possible. The traditional orchard habitat will be retained and protected, with just small areas (0.17 ha in total) of less valuable habitat within this habitat complex lost. Works will proceed following standard good practice working methods for environmental protection. An appropriate control/eradication strategy	Minor adverse as a result of small scale permanent habitat loss. Once newly created habitats are established, there will be an overall increase in the total area of valuable habitats, resulting in long term benefits. While long term benefits of habitat creation will exceed the habitat loss, there will be a loss of existing habitat so both adverse and beneficial impacts are reported as minor on a	Neutral

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-3Table 7-3)	Significance Ccategory (rRefer to Table 7-3)
			will be in place to ensure that the spread of INNS is avoided. Habitat creation will offset the effects of habitat loss.	precautionary basis. Overall, the significance of effects is reported as neutral (rather than slight beneficial) on this precautionary basis.	
		Operation: Habitat degradation as a result of air and water pollution.	The drainage strategy to be implemented by the Scheme incorporates SuDS to mitigate the pollution risk associated with road runoff as well as accidental spills. The Scheme will result in small increases in NOx levels and nitrogen deposition in localised areas adjacent to the highway as a result of predicted traffic increases (it should be noted that this habitat type does not require detailed air quality assessment as per LA 105). However, significant effects are not anticipated, given the small-scale changes anticipated in localised areas, and considering that surveys have shown that a range of habitat types have established and persisted adjacent to the busy M5 and A4019 corridors.	Minor adverse as a result of small scale, localised air quality effects. Overall the significance of effects is reported as slight (rather than neutral) on a precautionary basis.	Slight

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-3)	Significance Ccategory (rRefer to Table 7-3)
Terrestrial habitat – hedgerows Terrestrial habitat – A4019 habitat complex Terrestrial habitat – M5 Junction 10 and motorway embankments habitat complex	Local	Construction: Habitat loss and potential for habitat degradation as a result of air and water pollution.	Existing vegetation will be retained as far as possible. Works will proceed following standard good practice working methods for environmental protection. An appropriate control/eradication strategy will be in place to ensure that the spread of INNS is avoided. Habitat creation will offset the effects of habitat loss. Creation of 11.35 km of species-rich hedgerow will compensate for the loss of 0.7 km of species-rich hedgerow and 8.45 km of species-poor hedgerow	Minor adverse as a result of permanent habitat loss. Once newly created habitats are established, there will be an overall increase in the total area of valuable habitats including wetland habitats, scrub, woodland, hedgerows and species-rich grassland which will result in long term benefits. While long term benefits of habitat creation will exceed the habitat loss, there will be a loss of existing habitat so both adverse and beneficial impacts are reported as minor on a precautionary basis. Overall, the significance of effects is reported as neutral (rather than slight beneficial) on this precautionary basis.	Neutral
		Operation: Habitat degradation as a result of air and water pollution and habitat fragmentation.	The drainage strategy to be implemented by the Scheme incorporates SuDS to mitigate the pollution risk associated with road runoff as well as accidental spills. The Scheme will result in small increases in NOx levels and nitrogen deposition in localised areas adjacent to the highway as a result of predicted traffic increases (it	Minor adverse as a result of small scale, localised air quality effects. Overall, the significance of effects is reported as slight (rather than neutral) on a precautionary basis.	Slight

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-2)	Significance Ccategory (rRefer to Table 7-3)
			should be noted that this habitat type does not warrant detailed air quality assessment as per LA 105). However, significant effects are not anticipated, given the small-scale changes anticipated in localised areas, and considering that surveys have shown that a range of habitat types have established and persisted adjacent to the busy M5 and A4019 corridors. Creation of green corridors which link to habitat in the wider landscape will offset the effects of fragmentation.		
Bats	Regional	Construction: Loss and disturbance of roosts Temporary loss of foraging and commuting habitat before the habitat creation areas become established	All works that could impact on roosting bats would be carried out under a Natural England EPS mitigation licence for bats. Construction of two compensatory bat roost structures prior to works and installation of additional bat roosting features including bat boxes and tree features. Implementation of buffer zones and sensitive timings of works (such as undertaking works within	Minor Adverse	Slight

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-3)	Significance Ccategory (rRefer to Table 7-3)
			40 m of a known bat roost outside key periods, including the breeding period). Localised usage of acoustic barriers to reduce risk of disturbance. Pre-construction surveys. Temporary installation of Heras fencing or dead hedging to protect flight lines. Creation of replacement habitat, which includes a net increase in broadleaved woodland, hedgerows, species-rich and scrub. Creation of strong linear planting features such as hedgerows, hedgerows with trees and woodland, which will provide a network of habitat features to ensure bats can move around the landscape.		
		Operation: Habitat fragmentation as a result of habitat loss around the junction, severance of hedgerows and the River Chelt along the Link Road and widening the A4019.	Construction of a clear span bridge over the River Chelt. Construction of the Withybridge (A4019) underpass east of the M5 Junction 10. Planting to create bat “hop-overs” and linear planting to	Minor Adverse	Slight

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-2)	Significance Ceategory (rRefer to Table 7-3)
		Habitat fragmentation as a result of increased lighting could result in alterations to bat commuting routes which may expose them to new risks.	direct bats to safe crossing points. Creation of strong linear planting features such as hedgerows, hedgerows with trees and woodland, which will provide a network of habitat features to ensure bats can move around the landscape. Inclusion of two dark corridors along the A4019 east and west of Uckington. Wildlife-friendly lighting to be installed. A dark corridor will be enforced around bat roosts and any compensatory bat roosting features. Lighting will be warm light and include louvers to reduce backspill.		
Dormouse	County	Construction: Temporary loss of habitat which could support dormouse, including hedgerows. Temporary habitat fragmentation and severance to the north of the A4019 and the east of the M5, until new hedgerow planting	All clearance of dormouse habitat will be carried out using, where appropriate, a combination of a PMW and Natural England EPS Mitigation licence for dormice. Advance habitat creation will provide continued habitat resource and connectivity for dormice, as well as installation of dormouse nest	Negligible adverse due to the time for newly created habitats to establish and as a result of displacement of individuals. While habitat creation will result in a long term increase in suitable habitat for this species, a negligible adverse level of impact is reported on a precautionary basis. Overall, the significance of effects is	Neutral

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-2)	Significance Ccategory (rRefer to Table 7-3)
		becomes established. Incidental mortality, injury or disturbance (noise, lighting and visual) to individuals and damage or destruction of nests (e.g. resting or breeding sites) during construction.	boxes within and adjacent to retained vegetation prior to vegetation clearance. Hedgerow, scrub and woodland planting will replace any habitat lost in this area with better quality habitat that will strengthen the linear vegetation features. Phased vegetation clearance will be undertaken in the presence of a licensed ecologist. Post-construction monitoring of the dormouse population will be undertaken in accordance with the Method Statement that will form part of the licence application, which will be agreed with Natural England.	reported as neutral (rather than slight).	
		Operation: N/A	NA	No change	Neutral
Otter	County	Construction: Disturbance to commuting, foraging and resting otter. Degradation of habitats via pollution events.	Noise and vibration will be minimised within a 250 m buffer of any active otter resting sites. Haul roads, lay down areas and compounds will be located at least 10 m from watercourses used by otter where possible.	Negligible adverse as a result of potential for temporary disturbance. Overall, the significance of effects is reported as slight (rather than neutral) on a precautionary basis.	Slight

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-2)	Significance Ccategory (rRefer to Table 7-3)
			Night-time working will be avoided where possible within this buffer In-channel works will be avoided where possible, and potential otter commuting routes within suitable habitats (River Chelt, Leigh Brook, MW4) including existing underpass structures beneath the M5 will remain open and unblocked to avoid forcing otters to cross over the M5 carriageway instead. Provision of artificial lighting during the construction phase of the Scheme will be minimised and designed to avoid artificial illumination of watercourses adjacent to the site including the River Chelt, Leigh Brook, and MW4, and adjacent scrub/woodland habitats. Works will proceed following standard good practice working methods for environmental protection.		
		Operation: Injury/mortality of otters as a result of collision with vehicles if the	The proposed new road will comprise a clear span structure over the River Chelt and, therefore, the River	No change	Neutral

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-2)	Significance Ccategory (rRefer to Table 7-3)
		carriageway is accessible from adjacent land. Degradation of habitats via pollution events.	Chelt channel and banks will be retained beneath. An otter underpass within 50 m to the south of the River Chelt and associated landscape planting, will reduce the risk of injury/mortality to otters as a result of collision with vehicles. An otter ledge will be retrofitted to the existing River Chelt culvert beneath the M5 to improve this crossing feature for otters. Installation of otter proof fencing within 100 m of the River Chelt will prevent otters from reaching the live carriageway . The drainage strategy to be implemented by the Scheme incorporates SuDS to mitigate the pollution risk associated with road runoff as well as accidental spills.		
Other priority mammals	Local	Construction: Temporary removal of vegetation that supports hedgehog, brown hare, polecat and harvest mouse.	Vegetation clearance will be kept to a minimum. Ecological briefings and toolbox talks for all site operatives to make them aware of relevant constraints and requirements prior to	Negligible adverse due to the time for newly created habitats to establish.	Neutral

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-3)	Significance Ccategory (rRefer to Table 7-3)
			commencing work on the Scheme. Covering excavations overnight or incorporating features such as ramps to prevent animals getting trapped. Habitat creation including grassland, scrub, hedgerow and woodland planting will result in a permanent long-term increase in the total area of suitable habitat available for priority mammal species.		
		Operation: Fragmentation and collision with vehicles	Underpasses are proposed to allow safe movement of mammals and prevent populations becoming fragmented.	No change	Neutral
Breeding birds (excluding barn owl)	Local	Construction: Short term loss of foraging and nesting habitat for breeding and wintering birds. Killing/injury of individual birds, and destruction of nests and eggs. Construction activities in the vicinity of known Schedule 1 bird sites could result in disturbance impacts	Vegetation clearance will be kept to a minimum. Habitat creation including hedgerow and woodland planting and species-rich grassland creation will result in a permanent long-term increase in the total area of suitable foraging and nesting habitat available to birds. Clearance of suitable bird nesting habitat will be undertaken outside of the	Negligible adverse due to the time for newly created habitats to establish and temporary disturbance.	Neutral

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-3)	Significance Ccategory (rRefer to Table 7-3)
		which could prevent these bird species from using their entire territory.	main bird nesting season (generally March to August inclusive in southern England) as far as possible. 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. Restrict construction activities in the vicinity of Schedule 1 bird nests while they are active. Pre-construction breeding bird surveys will be required during the relevant breeding seasons to determine the exact location of any nesting Schedule 1 species. Bird boxes will be erected to compensate for the loss of territory suitable for priority hole-nesting species. Night working will be avoided where possible and any		

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-2)	Significance Ccategory (rRefer to Table 7-3)
			lighting required for construction will be designed sensitively to avoid illuminating features used by roosting birds such as hedgerows and woodland/scrub edge. Good working practices will be employed in order to minimise noise impacts during construction and operation.		
		Operation: Noise and visual disturbance which may deter birds from foraging or nesting close to the Scheme.	Installation of additional nest boxes situated at least 50 m from the construction footprint.	No change	Neutral
Wintering birds	Local	Construction: Short term loss of foraging habitat. Construction activities could result in disturbance impacts which could prevent birds from using certain areas of habitat.	Vegetation clearance will be kept to a minimum. Habitat creation including hedgerow and woodland planting and species-rich grassland creation will result in a permanent long-term increase in the total area of suitable foraging habitat available to birds. Night working will be avoided where possible and any lighting required for construction will be designed sensitively to avoid	Negligible adverse due to the time for newly created habitats to establish and temporary disturbance.	Neutral

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-2)	Significance Ccategory (rRefer to Table 7-3)
			illuminating features used by roosting birds such as hedgerows and woodland/scrub edge. Good working practices will be employed in order to minimise noise impacts during construction and operation.		
		Operation: Noise and visual disturbance which may deter birds from foraging or nesting close to the Scheme.	N/A	No change	Neutral
Barn owl	County	Construction: Disturbance to foraging barn owl, temporarily preventing barn owl from using their entire territory. Loss of a small area of potential foraging habitat.	Pre-construction surveys of any potential nest site within 150 m of the works. Good working practices will be employed in order to minimise noise impacts during construction and operation. Vegetation clearance will be kept to a minimum. Habitat creation will result in the permanent long-term increase in suitable foraging habitat. As enhancement four barn owl boxes will be installed	Negligible adverse due to the time for newly created habitats to establish and some temporary disturbance to foraging barn owl. Overall, the significance of effects is reported as slight (rather than neutral) on a precautionary basis.	Slight

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-2)	Significance Ccategory (rRefer to Table 7-3)
			outside of 1.5 km of the Scheme boundary (and 1.5 km from any major road).		
		Operation: Mortality from collision with vehicles as a result of changes to traffic and design of roads and changes to existing vegetation screening.	Planting trees, hedgerows, blocks of woodland and linear belts of trees and shrubs to provide a screen, encouraging barn owls to fly at height above vehicles. As enhancement, four barn owl boxes will be installed outside of 1.5 km of the Scheme boundary (and 1.5 km from any major road).	Negligible adverse due to the time for newly created habitats to establish. Overall, the significance of effects is reported as slight (rather than neutral) on a precautionary basis.	Slight
Reptiles	Local	Construction: Removal of vegetation suitable for widespread reptile species. Short-term loss in habitat availability during the construction phase of the Scheme. Potential to incidentally kill or injure reptiles during construction.	Habitat creation including grassland, scrub, hedgerow and woodland planting, and provision of natural refugia / habitat piles within retained and newly created habitat areas, will result in a permanent long-term increase in the total area of suitable reptile habitat available. The provision of habitat will be provided in advance of commencement of construction works during vegetation clearance to allow reptiles to be displaced into suitable established habitat.	Negligible adverse due to the time for newly created habitats to establish.	Neutral

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-2)	Significance Ccategory (rRefer to Table 7-3)
			Vegetation clearance will take place under a PMW with guidance from an onsite ecologist, using a two-stage cut to persuade reptiles away from the working area.		
		Operation: Fragmentation and collision with vehicles	Underpasses are proposed to allow safe movement of reptiles and prevent populations becoming fragmented.	No change	Neutral
Great crested newt	County	Construction: Loss of terrestrial habitat. Potential to incidentally kill or injure great crested newts during construction.	All clearance of great crested newt habitat will be carried out under a district level licence and measures will be implemented to avoid accidentally killing or injuring any animals. Habitat creation including habitat piles, species-rich grassland, scrub, hedgerow and woodland planting will result in a permanent long-term increase in the total area of suitable great crested newt terrestrial habitat available. No ponds specifically for great crested newts will be created, although the six attenuation basins and the wetland habitat within the flood storage area will be designed to benefit	Negligible adverse due to the time for newly created habitats to establish. While habitat creation will result in a long term increase in suitable habitat for this species, a negligible adverse level of impact is reported on a precautionary basis. Overall, the significance of effects is reported as neutral (rather than slight).	Neutral

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-3)	Significance Ccategory (rRefer to Table 7-3)
			biodiversity, including great crested newts.		
		Operation: Fragmentation and collision with vehicles	Underpasses are proposed to allow safe movement of amphibians and prevent populations becoming fragmented.	No change	Neutral
Common toad	Local	Construction: Loss of terrestrial habitat. Potential to incidentally kill or injure common toad during construction.	Vegetation clearance will be kept to a minimum. Ecological briefings and toolbox talks for all site operatives to make them aware of relevant constraints and requirements prior to commencing work on the Scheme. Covering excavations overnight or incorporating features such as ramps to prevent animals getting trapped. Habitat creation including habitat piles, grassland, scrub, hedgerow and woodland planting will result in a permanent long-term increase in the total area of suitable terrestrial habitat available for common toad.	Negligible adverse due to the time for newly created habitats to establish.	Neutral
		Operation:	Underpasses are proposed to allow safe movement of common toads and prevent	No change	Neutral

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-3)	Significance Ccategory (rRefer to Table 7-3)
		Fragmentation and collision with vehicles	populations becoming fragmented.		
River Chelt	County	Construction: Permanent shading of the River Chelt under a proposed new bridge and temporary shading under the temporary haul bridge. Temporary de-vegetation of the riparian zone is likely to be required to facilitate construction of the structure. Construction disturbance to aquatic species. Minor riparian habitat loss associated with works to Drain 21 (a tributary of the River Chelt).	The new River Chelt Bridge to accommodate the Link Road has been designed to be clear span with no permanent interactions with the watercourse bed. A short length of bank protection is required, details of which are to be confirmed at detailed design. The Scheme design has been developed to ensure there is no physical alterations to the existing M5 River Chelt Culvert or the channel bed and banks. Standard good practice pollution prevention measures and silt management/control measures will be implemented throughout the construction period to avoid pollution to watercourses. Construction of the River Chelt bridge will avoid ecologically sensitive periods for fish species, e.g. migratory/spawning periods, in particular for qualifying fish	Minor adverse Overall, the significance of effects is reported as slight (rather than neutral) on a precautionary basis.	Slight

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-3)	Significance Ccategory (rRefer to Table 7-3)
			species of the Severn Estuary SAC /Ramsar Site. Should partial dewatering of the River Chelt channel be required to facilitate the works, a fish rescue plan will be developed in consultation with the Environment Agency to ensure protection of fish. To minimise disturbance to aquatic species, all haul roads, lay down areas and compounds will be located at least 10 m from watercourses, except where access is required to specific locations for works to bridges/culverts for example. Re-instatement of riparian vegetation and habitat following construction.		
		Operation: Minor changes to out of bank flood flows.	Embedded mitigation has been incorporated into the drainage strategy to allow for management of volumes and quality of any surface water run-off. Flows from drainage attenuation basins will be restricted to greenfield runoff rates reducing any impact to flow velocities and volumes from runoff.	Negligible adverse Overall, the significance of effects is reported as neutral (rather than slight) taking into account the level of impact and mitigation.	Neutral

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-2)	Significance Ccategory (rRefer to Table 7-3)
Leigh Brook	Local	Construction: Permanent loss of open channel and riparian habitat resulting from an extension of Leigh Brook Culvert - 16.35 m total extension. Temporary in-channel habitat loss and harm/mortality to fish associated with potential over-pumping or fluming of the Leigh Brook to facilitate the Leigh Brook Culvert extension~~Temporary in-channel habitat loss associated with over-pumping of the Leigh Brook to facilitate the Leigh Brook Culvert extension~~. Temporary disturbance to aquatic and riparian species associated with drainage outfall (open cut channel).	Standard good practice pollution prevention measures and silt management/control measures will be implemented throughout the construction period to avoid pollution to watercourses. Re-instatement of riparian vegetation and habitat following construction. Provision of embedded culvert inverts for the extension 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. Construction of the Leigh Brook culvert will avoid ecologically sensitive periods for fish species, e.g., migratory/spawning periods, in particular for qualifying fish species of the Severn	Minor adverse Overall, the significance of effects is reported as slight (rather than neutral) on a precautionary basis.	Slight

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-3)	Significance Ccategory (rRefer to Table 7-3)
			Estuary SAC /Ramsar Site where possible. Should dewatering and over-pumping or fluming of the Leigh Brook channel be required to facilitate the works, a fish rescue plan will be developed in consultation with the Environment Agency to ensure protection of fish.		
		Operation: Minor changes to out of bank flood flow. Potential permanent changes in water quality.	Embedded mitigation has been incorporated into the drainage strategy to allow for management of volumes and quality of any surface water run-off. Flows from drainage attenuation basins will be restricted to greenfield runoff rates reducing any impact to flow velocities and volumes from runoff. The drainage design provides sufficient mitigation to ensure any change in water quality as a result of highways runoff will be compliant with Environmental Quality Standards based on the HEWRAT.	Minor adverse Overall, the significance of effects is reported as slight (rather than neutral) on a precautionary basis.	Slight
Other Ordinary Watercourses (MW3, Drain 8, Drain 9, Drain 10, Drain 11, Drain 12, Drain	Local	Construction: Minor temporary riparian vegetation loss to	Standard good practice pollution prevention measures and silt management/control	Minor adverse Overall the significance of effects is reported as slight	Slight

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-3Table 7-3)	Significance Ccategory (rRefer to Table 7-3)
14, Drain 15, Drain 16, Drain 20, Drain 21 and Drain 22)		facilitate construction of an adjacent attenuation basin and associated drainage outfall (Leigh Brook, MW3, Drain 21). Localised realignment resulting in temporary habitat loss during construction (Drains 8, 9, 10, 11, 16, 20). Permanent loss of habitat associated with new culverts / culvert extensions (Drains 8, 10, 12, 15). At Drain 22, approximately 100 m of open channel habitat, although of limited value for aquatic species, will be lost under the Piffs Elm Culvert extension. Temporary disturbance to riparian/in-channel aquatic species for all other ordinary watercourses Regrading of watercourse to improve continuity of flow and facilitate drainage (Drain 21).	measures will be implemented throughout the construction period to avoid pollution to watercourses. Ecologically and geomorphologically sensitive realignment design to be applied to improve habitat condition. Provision of embedded culvert inverts 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. Minimisation of culvert length through adoption of a perpendicular alignment to the highway and use of wingwalls. Ditch replacement strategy will ensure there is a net gain in ditch length and that any riparian vegetation that is lost	(rather than neutral) on a precautionary basis.	

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-2)	Significance Ccategory (rRefer to Table 7-3)
		Drain 12 will also be crossed by a box culvert along the Link Road.	to ditch works is reinstated following construction.		
		Operation: MW3, Drain 8, Drain 15 and Drain 21 are incorporated into the drainage strategy. Potential permanent changes in water quality (Drains 10, 11).	Embedded mitigation has been incorporated into the drainage strategy to allow for management of volumes and quality of any surface water run-off. Flows from drainage attenuation basins will be restricted to greenfield runoff rates reducing any impact to flow velocities and volumes from runoff. The drainage design provides sufficient mitigation to ensure any change in water quality as a result of highways runoff will be compliant with Environmental Quality Standards based on the HEWRAT.	Minor adverse	Neutral
Standing waterbodies	Local	Construction No construction impacts identified.	Standard good practice pollution prevention measures and silt management/control measures will be implemented throughout the construction period to avoid pollution to adjacent standing waterbodies.	No change	Neutral
		Operation	N/A	No change	Neutral

Biodiversity Rresource	Value	Summary of Iimpacts	Mitigation (including Eembedded Mmitigation and Eessential Mmitigation).	Residual Eeffect (with Eembedded and Eessential Mmitigation) (Refer to Table 7-2Table 7-3)	Significance Ccategory (rRefer to Table 7-3)
		No operational impacts identified.			

7.9.2. As outlined in the table above, taking into account the embedded and essential mitigation measures proposed, significant residual effects in relation to biodiversity resources are not anticipated as a result of the Scheme.

7.9.3. Terrestrial habitats could potentially be subject to residual slight adverse effects during operation of the Scheme as a result of small scale, localised air quality effects. However, significant effects are not predicted, given the small-scale changes anticipated in localised areas, and considering that surveys have shown that a range of habitat types have established and persisted adjacent to the busy M5 and A4019 corridors. Furthermore, once newly created habitats are established and managed, there will be an overall increase in the total area of high-quality habitats, resulting in long term benefits.

7.9.4. Bats could potentially be subject to residual slight adverse effects during construction and operation as a result of loss and disturbance of roosts, temporary loss of foraging habitat and habitat fragmentation. Although the provision of alternative roosts, sensitive working methods and creation of replacement habitat reduces the effect, a slight adverse effect on bat populations is anticipated. Once habitats are established, there will be an overall increase in the area of suitable foraging habitat for bats.

7.9.5. Otter and barn owl could potentially be subject to residual slight adverse effects during construction. This is as a result of potential for some temporary disturbance. Barn owl could also subject to residual slight adverse effects during operation as a result of the time taken for screening habitats to establish. However, such residual effects are minimal.

7.9.6. The River Chelt and other ordinary watercourses could potentially be subject to residual slight adverse effects during construction as a result of some habitat loss. The Leigh Brook could potentially be subject to residual slight adverse effects during construction and operation as a result of some habitat loss during construction and potential adverse effects on water quality during operation. However, such residual effects are minimal.

7.10. Cumulative effects assessment

7.10.1. This section considers the cumulative effects of the Scheme and the Scheme interacting with other Reasonably Foreseeable Future Projects (RFFPs) within the biodiversity topic.

7.10.2. The further consideration of cross-topic intra-Scheme and inter-project cumulative effects is reported in Chapter 15 – Cumulative Effects Assessment (~~application~~Application document ~~TR010063 – APP 6.13~~TR010063/APP/6.13).

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

7.10.3. The focus of the intra-Scheme CEA is understanding how receptors may experience a number of different types of impacts from the Scheme at the same time. Within the topic assessments, the biodiversity assessment methodology inherently includes consideration of all the different types of Scheme impacts for each biodiversity resource, and takes them all into account to give a single level of impact for each resource. For example, with regard to terrestrial habitats, the impact assessment considers the potential for habitat loss and habitat degradation as a result of pollution; and with regard to dormouse, the impact assessment considers the potential for habitat loss, including damage or destruction of nests, habitat fragmentation, disturbance from noise and lighting, and injury or mortality. Therefore, this assessment inherently considers combined effects from different sources (within topic intra-Scheme effects).

7.10.4. Cross-topic intra-Scheme cumulative effects on biodiversity resources are also inherently assessed in the sections above. For example, the impact assessment considers the potential for noise and vibration and air quality impacts to result in effects on biodiversity

resources, as well as any impacts to the water environment and any effects in relation to aquatic biodiversity resources.

7.10.5. On the basis of the above, there are no additional intra-Scheme cumulative effects from the assessment of biodiversity to report in this section.

7.10.6. A comprehensive assessment of cross-topic intra-Scheme effects on all receptors is provided in Chapter 15 – Cumulative Effects Assessment (~~application~~Application document ~~TR010063 – APP 6.13~~TR010063/APP/6.13).

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

7.10.7. To complete the cumulative effects assessment inter-project 'within topic' element, the biodiversity assessment has been completed with reference to the list of RFFPs that has been developed for the Scheme. The list is based on a review of all developments known to the planning system using the methodology described in Chapter 4 – Environmental Assessment Methodology of the ES (~~application~~Application document ~~TR010063 – APP 6.2~~TR010063/APP/6.2).

7.10.8. The RFFP long-list was screened, identifying which RFFPs may result in inter-project cumulative effects in relation to the scope of the biodiversity assessment. The screening criteria used were as follows:

- The proximity of the RFFP to the Scheme, in accordance with the distance thresholds for different receptor types as set out previously in relation to the main biodiversity assessment.
- Potential for interactions, for example impacts to habitat with the potential to support protected species which the Scheme also supports. This includes projects that would result in demolition of existing structures or tree felling which could result in cumulative effects to roosting bats and barn owls.
- Exclusion of developments in heavily urbanised locations that are not adjacent to connecting watercourses.
- Potential for recreational pressure to designated sites.

7.10.9. The following RFFPs have been shortlisted:

- 22/00947/FUL – Hayden Hill Fruit Farm.
- 22/01272/FUL – Pigeon House Farm.
- 22/00164/PIP - Land known as Evergreen Spiritual Pathways.
- 19/00937/PDAD – Barns at Hayden Lane.
- 19/00907/PDAD – A&B Buildings at Pilgrove Farm.
- 22/02172/FUL – Pilgrove Cottage.
- 20/02132/FUL - Warners of Cheltenham Blaisdon Way.
- 21/00872/REM Phase 1 Land at Old Gloucester Road – relating to part of the land allocated under Policy HD8 – strategic development site in Cheltenham Local Plan – land to the north of B4634 including Hayden Allotments.
- 16/02000/OUT (Elms Park) – relating to land allocated under Policy A4 – North West Cheltenham Development Area.

- 20/00759/FUL (Swindon Farm) – relating to part of the land allocated under Policy A4 – North West Cheltenham Development Area.
- Safeguarded land to the north-west of Cheltenham (Policy SD5).
- 22/01817/OUT and 22/01107/OUT (Land to the south of Old Gloucester Road (B4634)) – relating to land allocated under Policy A7 – West Cheltenham Development.
- 22/01163/FUL - Uckington Farm, The Green.

Hayden Hill Fruit Farm

7.10.10. The Hayden Hill Fruit Farm application, located adjacent to the north of the Order limits at the southern end of the Link Road, is for the demolition of an existing barn and bungalow (one building) and replacement with a new residential property. A planning decision is awaited. The building to be demolished is within the bat and barn owl survey area for the Scheme. The building was assessed as having negligible potential to support roosting bats and was not considered suitable for supporting barn owl. Therefore, cumulative effects are not anticipated.

Pigeon House Farm

7.10.11. The Pigeon House Farm application, located approximately 60 m from the Order limits at Uckington north of the A4019, is for the removal of two agricultural buildings and the construction of four residential properties. Planning permission was granted in September 2022 and it is anticipated that the development will be completed during construction of the Scheme.

7.10.12. The buildings were within the barn owl survey area for the Scheme; however, they were screened out of the barn owl assessment as being unsuitable. The buildings are now outside of the bat roost survey area for the Scheme and were not surveyed as part of the assessment for the Scheme. An ecological report for the Pigeon House Farm proposals[161] assessed the buildings as having negligible potential for supporting bats and birds, and no evidence of bats was found during an internal inspection (undertaken in December 2021). On the basis that the buildings are unlikely to support bats and barn owls, cumulative effects are not anticipated.

Land known as Evergreen Spiritual Pathways

7.10.13. The Land known as Evergreen Spiritual Pathways application, located approximately 150 m from the Order limits at Uckington north of the A4019, is for the demolition of the existing structure and construction of up to three residential properties. Planning permission was granted in July 2022 and it is anticipated that the development will be underway, progressing to partially completed during the construction of the Scheme.

7.10.14. The existing building was within the barn owl survey area for the Scheme, however it was screened out of the barn owl assessment as being unsuitable. The existing building is outside of the bat roost survey area for the Scheme, and no information about its potential to support roosting bats is available. In the event that the existing building supports roosting bats, or has the potential to support roosting bats, its importance to this species group could be increased as a result of loss of the roost resource in the local area, as a result of building demolition for the Scheme. However, the provision of compensatory roost structures prior to any demolition for the Scheme will ensure that the overall roost

[161] Unknown author (January 2022) A Preliminary Ecological Assessment of the Land and Barns at Pigeon House Farm, Uckington. Online: https://publicaccess.tewkesbury.gov.uk/online-applications/files/AADA7EE6C18D7D2161A98457F86A8210/pdf/22_00466_FUL-A_PRELIMINARY_ECOLOGICAL_ASSESSMENT-1046047.pdf

resource is maintained. As a result, and given the small scale nature of the planning application, cumulative effects are not anticipated.

Barns at Hayden Lane

7.10.15. The Hayden Barn applications, located approximately 100 m south of the B4634, are for the conversion of agricultural buildings into one larger residential ~~dwelling~~property. Prior approval was granted on 15 November 2019 (the application was re-submitted with amendments). It is anticipated that the development will be completed during construction of the Scheme. The buildings were within the barn owl survey area for the Scheme, however they were considered unsuitable for supporting barn owl. The existing building is outside of the bat roost survey area for the Scheme, and no information about its potential to support roosting bats is available. In the event that the existing building supports roosting bats, or has the potential to support roosting bats, its importance to this species group could be increased as a result of loss of the roost resource in the local area, as a result of building demolition for the Scheme. However, the provision of compensatory roost structures prior to any demolition for the Scheme will ensure that the overall roost resource is maintained. As a result, and given the small scale nature of the planning application, cumulative effects are not anticipated.

A&B Buildings at Pilgrove Farm

7.10.16. A&B Buildings at Pilgrove Farm, located approximately 280 m east of the Scheme along the B4634, is an application for conversion of two agricultural buildings into two larger residential ~~dwellings~~properties. Prior approval was granted on 15 November 2019, and it is anticipated that the development will be completed during construction of the Scheme.

7.10.17. The two buildings were within the barn owl survey area for the Scheme. One could not be fully accessed and is assumed to be a potential nest site. At the other building evidence of barn owl was recorded (an old pellet and potential barn owl feather) however, current evidence suggests that this is not an active roost site or occupied breeding site for barn owl. The Scheme will not result in the loss of any potential nest sites, active roost sites or occupied breeding sites, but there may be some temporary disturbance to foraging barn owl during construction and a short term reduction in screening during operation, potentially increasing the risk of mortality as a result of collision with vehicles. The Pilgrove Farm development will result in the removal of one potential nest site. A survey for the Pilgrove Farm buildings[162] recommended that works commence outside of the bird nesting season. Combined, the Scheme and the Pilgrove Farm development would not result in significant cumulative effects to barn owl, particularly given the availability of alternative nesting, roosting and foraging sites for barn owl in the wider area.

7.10.18. A survey for the Pilgrove Farm buildings[162] involved a full inspection of both buildings for bats in April 2019, and no evidence of bats was found. The report indicated that the buildings were unsuitable for roosting bats and did not recommend any further surveys. Cumulative effects in respect of bats are not anticipated.

Pilgrove Cottage

7.10.19. Pilgrove Cottage, located approximately 400 m east of the Scheme along the B4634, is an application for four detached houses with associated parking and landscaping. Planning permission was granted in March 2023 and it is assumed that construction of the Scheme and construction works at Pilgrove Cottage will overlap.

7.10.20. The site was within the barn owl survey area for the Scheme; however, it was screened out of the barn owl assessment as being unsuitable.

7.10.21. A survey of the Pilgrove Cottage site[163] identified that the only buildings on site comprised metal container sheds which were assessed as having negligible suitability for supporting

[162] Elizabeth Mckay (April 2019) Baseline Bat Survey Pilgrove Farm Old Gloucester Road, Cheltenham
[163] Wild Service (January 2023) Pilgrove Cottage Preliminary Ecological Appraisal.

roosting bats. The survey report confirmed that there are a number of trees throughout the site, one of which was assessed as having high suitability to support roosting bats, with the remainder unsuitable. The majority of trees will be retained, but the tree with high suitability for supporting roosting bats will be removed, and further surveys will be necessary to confirm the presence or likely absence of roosting bats.

7.10.22. The importance of this tree to roosting bats could be increased as a result of loss of the roost resource in the local area, as a result of the Scheme, and similarly felling of this tree could increase use of one or more trees within the Scheme area. If the further bat survey of this tree confirms the presence of roosting bats, then it is assumed that appropriate mitigation and compensation will be incorporated into the Pilgrove Cottage site. Furthermore, the provision of compensatory roost structures prior to any demolition for the Scheme, and the precautionary approach that has been taken with regard to provision of compensation for loss of potential tree roosts, which will be refined following pre-construction surveys, will ensure that the overall roost resource is maintained. As a result, and given the small scale nature of the planning application, cumulative effects are not anticipated.

Warners of Cheltenham Blaisdon Way

7.10.23. Warners of Cheltenham Blaisdon is for the construction of 12 business units. It is located in a built up area on the outskirts of Cheltenham, adjacent to the River Chelt, approximately 1.5 km upstream of the Link Road crossing over the River Chelt. Planning permission was granted on 2 July 2021, and it is assumed that the development will be completed by the time the Scheme is constructed.

7.10.24. Consideration has been given to the potential for cumulative effects on the River Chelt as a result of pollution. However, considering the embedded mitigation measures which incorporate following standard good practice working methods for environmental protection, pollution of the River Chelt as a result of the Scheme is considered highly unlikely. Furthermore, it is assumed that the Warners of Cheltenham proposals would also comply with pollution control measures during operation (as the RFFP will be operational when the Scheme is constructed) in order to meet relevant legislation. Therefore, cumulative effects are not anticipated.

7.10.25. Consideration has also been given to whether operational disturbance effects to otters as a result of the RFFP could combine with temporary construction phase disturbance from the Scheme. This is not anticipated as the RFFP site is already built up and is unlikely to be of particular importance to otters.

Phase 1 Land at Old Gloucester Road

7.10.26. This is an application for 85 homes in the south-western portion of the larger 11.3 ha site that is allocated in the Cheltenham Plan[13] for a total of 175 homes. It is located on the outskirts of Cheltenham, between the B4634 and the River Chelt, approximately 800 m upstream of the Link Road crossing over the River Chelt. The development proposed in the south western part of the site is subject to a consented planning application for 85 dwellings, associated open space, landscaping and infrastructure, and it is anticipated that construction will commence imminently. The remainder of the site is identified in the Local Plan as having multiple constraints that need to be resolved through masterplanning (flood risk, green belt, presence of allotment gardens, proximity of Scheduled Monument and requirement to resolve future of nurseries within the site).

7.10.27. For the purposes of the CEA, it is assumed that enabling works and some infrastructure works will be underway at the RFFP at the time of Scheme construction commencement. It is also assumed that 50% of the RFFP will be built out during the Scheme construction phase – this equates to 43 units. It is assumed that the remaining 42 units would be built out early in the Scheme operational phase.

7.10.28. The RFFP area appears to comprise predominantly built up areas, low quality grassland and arable habitats, with the River Chelt corridor and hedgerows/tree lines bounding the fields being of greater nature conservation value.

7.10.29. The RFFP was within the barn owl survey area for the Scheme, although the majority of the RFFP site (the allotments and other built up areas, and an arable field) was scoped out as being unsuitable for barn owls.

7.10.30. Consideration has been given to the potential for cumulative effects on the River Chelt as a result of pollution during the construction and operational Phase of the Scheme and the construction and operational phases of the RFFP. However, considering the embedded mitigation measures which incorporate pollution prevention measures during construction and SuDS to mitigate the pollution risk associated with road runoff as well as accidental spills during operation, pollution of the River Chelt as a result of the construction and operational phases of the Scheme is considered highly unlikely. Furthermore, it is assumed that the RFFP would also comply with pollution control measures during construction and operation in order to adhere to relevant legislation. Therefore, cumulative effects due to pollution are not anticipated.

7.10.31. The Scheme has the potential to result in some minor temporary disturbance to commuting, foraging and resting otter during construction. In the event that otters are using the stretch of the River Chelt within and surrounding the RFFP, the RFFP has the potential to add to such impacts. However, taking into account the minimal impacts to otter during construction of the Scheme, and assuming that the RFFP would implement best practice measures to avoid or minimise any disturbance, any combined impacts are likely to be minor, temporary and not significant. No operational effects to otters are anticipated during the operational phase of the Scheme; therefore, the RFFP would not add to any Scheme related operational effects. Overall, no significant cumulative effects in respect of otters are anticipated.

7.10.32. The RFFP site could support habitats of value to foraging and commuting bats, particularly the River Chelt corridor and hedgerows/tree lines. The trees could also support roosting bats. In the event that the trees support roosting bats, or have the potential to support roosting bats, their importance to this species group could be increased as a result of loss of the roost resource in the local area, as a result of building demolition/tree felling for the Scheme, and similarly, felling of any trees suitable to support roosts at the RFFP could increase use of one or more trees within the Scheme area. However, the provision of compensatory roost structures prior to any demolition for the Scheme, and the precautionary approach that has been taken with regard to provision of compensation for loss of potential tree roosts, which will be refined following pre-construction surveys, will ensure that the overall roost resource is maintained. Furthermore, it is assumed that surveys would be undertaken of the RFFP site and, in the event that bat roosts or important foraging/commuting habitat was identified, any impacts would be effectively mitigated in compliance with legislation and best practice environmental design. On this basis, cumulative effects are not anticipated.

7.10.33. The great crested newt and dormouse populations identified within the Scheme's study area are located on the opposite side of the River Chelt to the RFFP and, in the case of dormice, on the opposite side of the A4019. Both features act as a barrier to dormouse and great crested newt dispersal, and therefore cumulative effects with respect to dormouse and great crested newts (if present within the RFFP site) are not anticipated.

North West Cheltenham Development Area

7.10.34. The North West Cheltenham Development Area is located to the east of Uckington stretching to the Gallagher Retail Park and Swindon Village and is allocated in the JCS at Policy A4. There are three planning applications relating to land within the allocated site – an outline application for Elms Park, a full planning application for Swindon Farm which was given consent in June 2023 and an outline application for Home Farm (this third

application has been scoped out of consideration for biodiversity interactions due to distance).

7.10.35. Application reference 16/02000/OUT is an outline application for up to 4,115 new homes and associated employment areas, retail, educational, and recreational facilities. This development is dependent upon transport improvements to progress, which will be delivered by the Scheme. The CEA assumptions (in Table 15-3 of Chapter 15 – Cumulative Effects Assessment [(~~application~~Application document ~~TR010063 – APP 6.13~~TR010063/APP/6.13]~~)~~) are that there will be some construction overlap, with the initial phases of the RFFP coinciding with the construction phase of the Scheme.

7.10.36. Application reference 20/00759/FUL is a full planning application for the demolition of a residential property and erection of a new residential development comprising 266 homes, with vehicular and pedestrian access from Manor Road, an attenuation basin and ancillary infrastructure. The CEA assumptions (in Table 15-3 of Chapter 15 – Cumulative Effects Assessment [(~~application~~Application document ~~TR010063 – APP 6.13~~TR010063/APP/6.13~~)~~]) are that there will be considerable construction overlap, with 25% of homes constructed at the point of Scheme construction commencing, rising to up to 75% of the homes constructed by the time the Scheme is operational.

7.10.37. The ES/Ecological Appraisal[164] for the RFFPs identified that the majority of the area (including the Elms Park and Swindon Farm sites) comprised semi-improved grassland, improved grassland or arable fields, all habitats of low nature conservation value. Habitats of higher nature conservation value included watercourses and associated woodland riparian habitat, small stands of plantation woodland and a number of veteran trees. A number of waterbodies were also present. Bat activity surveys recorded common pipistrelle most frequently, with only very low numbers of lesser horseshoe, barbastelle and greater horseshoe bat. Four small, low conservation status bat roosts were identified, one of which is outside of the boundary of the RFFPs. A number of species of farmland birds were recorded. The presence of great crested newts was confirmed within a waterbody in the north of the site. Dormice were identified within the Elms Park and Swindon Farm developments subsequent to the Elms Park ES. No reptiles, otter or water vole were recorded during targeted surveys.

7.10.38. The Elms Park ES (which also covered Swindon Farm) identified potentially significant effects in relation to loss of sections of hedgerows; removal of small numbers of mature trees and the loss of a single veteran tree; resulting impacts on bats, birds and great crested newts through loss of foraging, nesting and refuge habitats; and loss of arable farmland and semi-improved grassland and potentially significant effects on farmland birds and wintering birds respectively. However, the ES asserts that due to the implementation of a number of mitigation measures, including extensive habitat creation and retention and enhancement of existing habitats including existing green corridors, no significant residual effects will remain, and a minor beneficial effect is predicted. The only residual effect was predicted to be a minor adverse effect (not significant) on farmland birds including skylark, yellowhammer and linnet.

7.10.39. No specific impacts from the Scheme are expected in relation to the farmland bird species noted in the ES for the RFFPs, and it is considered unlikely that the Scheme would contribute to the minor adverse effect predicted as a result of the Elms Park and Swindon Farm developments.

[164] Bloor Homes, Persimmon (August 2016) Elms Park Environmental Statement
Bloor Homes and Persimmon Homes (March 2022) Elms Park, Cheltenham. Ecology Report – ES Addendum
Persimmon Homes (15 December 2021) Swindon Farm, Cheltenham Ecological Appraisal.
The Elms Park ES covers both the Elms Park and Swindon Farm sites and includes the impact assessment for both RFFPs combined.

7.10.40. Further consideration has been given to potential for inter-project cumulative effects on dormice, great crested newts and bats in the following points:

- The great crested newts identified at Elms Park and Swindon Farm are located well over 500 m from the Scheme and are not likely to be part of the metapopulation identified to the south of the Scheme. Cumulative effects in relation to great crested newts are therefore not anticipated.
- One small, occasionally used tree roost site for common pipistrelle bats will be lost as a result of the Swindon Farm development but is proposed in the application documents to be adequately mitigated for by the provision of alternative roost sites. Furthermore, the majority of habitat features identified as key foraging areas for bats are proposed to be retained and, following the implementation of extensive habitat creation and retention and enhancement of existing habitats including existing green corridors, beneficial effects are anticipated (as reported in the ES). The Scheme includes a compensatory bat roost mitigation structure within the North West Cheltenham Development Area – careful consideration has been given to integrating this with the published masterplan for the Elms Park proposals (16/02000/OUT), siting it adjacent to a hedgerow noted as intended for retention and within a dark corridor within the masterplan. However, given that the application is in outline and not yet associated with any consent, the CEA adopts a precautionary approach and notes the potential for cumulative additive inter-project effects in relation to bats.
- The ES for the applications state that the majority of habitats suitable for supporting dormice within the Elms Park and Swindon Farm developments will be retained, and substantial new habitat will be created. In addition, existing hedgerows will have gaps planted up and dormouse nest boxes will be installed to increase carrying capacity. The Scheme incorporates three hedgerows that are located within the Elms Park development as part of the dormouse mitigation strategy, located just north of the A4019, and proposes enhancement of these hedgerows through planting and nest box installation. Careful consideration has been given to integrating these Scheme proposals with the available information about the future development, noting that these hedgerows are identified for retention in the Elms Park masterplan. Whilst both the Scheme and the RFFPs will impact on the same population of dormice, it is considered that there is sufficient space available for effective mitigation and compensation, to ensure the maintenance of the favourable conservation status of this species. However, given that the larger application is outline, the CEA adopts a precautionary approach and notes the potential for cumulative additive inter-project effects in relation to dormice.

7.10.41. The CEA adopts a precautionary approach – in recognition that the Elms Park development ES conclusions are heavily reliant upon draft mitigation proposals and noting that detailed design is yet to come from the relevant developer, the potential for adverse additive inter-project cumulative effects for dormice and bats remains. The Scheme includes commitment CEA2 within the REAC (Application document ~~TR010063 – App 7.4~~TR010063/APP/7.4), which is intended to secure the continued efficacy and realise long term benefits of the Scheme environmental design in the context of strategic development sites, which include the North West Cheltenham Development Area, specifically to manage inter-project effects. The adverse effects could be significant; however, effective co-ordination between the Scheme promoter and developers (as advocated through CEA2) have the potential to manage these effects such that they would become non-significant. This could include a combination of co-ordinated environmental design and the development of phasing plans.

Safeguarded land to the north-west of Cheltenham

7.10.42. The safeguarded land to the north-west of Cheltenham is located between the M5 and Uckington, and is safeguarded in the JCS for meeting potential future development needs. This development is dependent on transport infrastructure improvements, which would be delivered by the Scheme. The CEA assumptions are that it could support around 2,000 homes and that there would be some construction overlap between enabling and infrastructure works at the RFFP during Scheme construction.

7.10.43. A proportion of this safeguarded land fell within the survey areas for the Scheme, indeed, the Scheme boundaries for both the Scheme and the safeguarded land overlap. Based on information collected during these surveys, desk study data and local knowledge, it is considered that the development of this site could add to the habitat lost within the local area, and may contribute to impacts on populations of dormice, bats, birds and reptiles. The more valuable habitats (to protected species) within this area are the Leigh Brook corridor and existing hedgerows.

7.10.44. The northern extent of the Withybridge (A4019) underpass proposed as part of the Scheme beneath the A4019 opens into this safeguarded land. Careful consideration has been given to integrating the underpass with this future development, ensuring that the mitigation is effective at a Scheme level, and also joins up with habitat in the wider landscape. Appropriate landscape planting has been included within the Scheme to direct bats towards the underpass including woodland and linear belts of trees and shrubs at the northern entrance of the underpass, extending west along the M5 verge and east parallel to the A4019.

7.10.45. Dormice have been confirmed to the north of the A4019 and east of the M5. The Scheme incorporates a number of hedgerows that are located within the safeguarded land as part of the dormouse mitigation strategy, and proposes retention and enhancement of these hedgerows, as well as planting a new hedgerow in place of an existing fence. Again, careful consideration has been given to integrating these proposals with this future development.

7.10.46. The CEA adopts a precautionary approach – in recognition that proposals for the RFFP are not yet in the public domain and have no planning status, the potential for adverse additive inter-project cumulative effects for dormice and bats remains. The Scheme includes commitment CEA2 within the REAC (aApplication document ~~TR010063 – App 7.4~~TR010063/APP/7.4), which is intended to secure the continued efficacy and realise long term benefits of the Scheme environmental design in the context of strategic development sites, which include the safeguarded land to the north west of Cheltenham, specifically to manage inter-project effects. The adverse effects could be significant; however, effective co-ordination between the Scheme promoter and developers (as advocated through CEA2) have the potential to manage these effects such that they would become non-significant. This could include a combination of co-ordinated environmental design and the development of phasing plans.

West Cheltenham Development Area

7.10.47. The West Cheltenham Development Area extends south of the B4634 and stretches between the proposed Link Road junction and Springbank. It is allocated in the JCS Policy A7 and there is an ~~application~~Application for outline planning application for development of part of the area (22/01817/OUT).

7.10.48. The application seeks outline consent and the masterplan proposals are conceptual only, including for residential development, sports pitches, a primary school and community hub. This development is dependent on the provision of transport infrastructure improvements, which will be delivered by the Scheme.

7.10.49. The CEA assumptions are that there would be some construction overlap between enabling and infrastructure works at the RFFP during Scheme construction.

7.10.50. The ES identified that the majority of the site comprised habitats of low ecological value (including arable and low quality grassland). The most valuable habitats within the site comprise woodland, hedgerows, trees, tree belts, wet ditches and ponds. One active badger sett was recorded. No evidence of dormouse, great crested newts or reptiles were recorded during targeted surveys and breeding and wintering bird surveys confirmed that the site was not of particular ornithological value. There are a number of trees present within the site that have features suitable to support roosting bats (although specific roost surveys have not been undertaken) and moderate bat activity was recorded throughout the site. Bat activity surveys recorded common pipistrelle most frequently, with only very occasional activity from lesser horseshoe bats, and individual recordings of serotine, greater horseshoe and barbastelle bat. The bat activity was predominantly associated with hedgerows and a copse of woodland.

7.10.51. The ES for the RFFP identified a potentially significant effect in relation to impacts to bats. Potentially significant effects were identified as a result of losses of small sections of hedgerows and woodland and potential disturbance from lighting. However, the ES asserts that due to the implementation of a number of mitigation measures, including a sympathetic lighting regime, buffering and enhancement to the hedgerow network and habitat creation, no significant residual effects will remain, and a slight beneficial effect is predicted. Furthermore, the ES commits to surveys to determine the presence of roosting bats within trees identified as potentially suitable. No other residual adverse effects were identified.

7.10.52. A proportion of the RFFP site fell within the survey areas for the Scheme, and a hedgerow at the western extent of the RFFP site, along with a hedgerow on the opposite site of the B4634, is a bat crossing point (CP5). The concept proposals from the RFFP developers indicate that this hedgerow will be retained. The concept proposals also indicate that the more valuable habitats, including the block of semi-natural broadleaved woodland (a priority habitat) and hedgerows would be retained within the proposals. These are the habitats of most value to protected species.

7.10.53. The CEA adopts a precautionary approach – in recognition that proposals for the RFFP have no planning status, the potential for adverse additive inter-project cumulative effects for bats remains. The Scheme includes commitment CEA2 within the REAC (Application document ~~TR010063 – App 7.4~~TR010063/APP/7.4), which is intended to secure the continued efficacy and realise long term benefits of the Scheme environmental design in the context of strategic development sites, which include the West Cheltenham Development Area, specifically to manage inter-project effects. The adverse effects could be significant; however, effective co-ordination between the Scheme promoter and developers (as advocated through CEA2) have the potential to manage these effects such that they would become non-significant. This could include a combination of co-ordinated environmental design and the development of phasing plans.

Uckington Farm, The Green

7.10.54. Uckington Farm is located adjacent to the Scheme at Uckington, north of the A4019. Proposals are for the demolition of agricultural buildings and construction of 16 residential properties. A decision is awaited. On a precautionary basis (assuming approval), it is assumed that there would be some construction overlap, with the development completed during construction of the Scheme.

7.10.55. The buildings that would be demolished at Uckington Farm were within the barn owl survey area for the Scheme, and barn owl presence has been confirmed, with active roost sites and potential nest sites identified within two buildings and one tree. Both buildings would be demolished as part of the Uckington Farm proposals. It is assumed that surveys would be undertaken of the RFFP site to confirm the status of barn owls, and that effective mitigation and compensation would be implemented to ensure compliance with legislation and best practice environmental design. The Scheme will not result in the loss of any potential nest sites, active roost sites or occupied breeding sites (which will be confirmed

through pre-construction surveys), but there may be some temporary disturbance to foraging barn owl during construction and a short term reduction in screening during operation, potentially increasing the risk of mortality as a result of collision with vehicles. Significant cumulative effects as a result of the Scheme and the Uckington Farm development are not anticipated, particularly given the availability of alternative nesting, roosting and foraging sites for barn owl in the wider area.

7.10.56. The buildings were also within the bat roost survey area for the Scheme and the presence of roosting bats has been confirmed, with common pipistrelle, *Myotis* (assumed to be Natterer's) and brown long-eared day roosts identified within the agricultural buildings to the south of the site, which would be demolished under the Uckington Farm proposals. Potential for temporary disturbance as a result of the Scheme has been identified, and appropriate mitigation comprising temporary noise barrier and compensatory roost features to maintain the overall roost resource have been incorporated into the Scheme. It is assumed that appropriate mitigation and compensation would be incorporated into the Uckington Farm site to account for roost loss, which would be undertaken under a EPS mitigation licence from Natural England. The importance of these buildings to roosting bats could be increased as a result of loss of the roost resource in the local area, as a result of the Scheme, and vice versa, highlighting the importance of pre-construction surveys for both the Scheme and Uckington Farm, to confirm status of roosts. On this basis, and given the low conservation status of the bat roosts likely to be present, significant cumulative effects in relation to bats are not anticipated.

7.10.57. Although dormice are known to be present to the north of the A4019 and east of the M5, the habitats likely to be present within the Uckington Farm site are considered unlikely to be suitable for dormice. Therefore, cumulative effects in relation to dormice are not anticipated. The great crested newt metapopulations identified within the Scheme area are located over 500 m from Uckington Farm or on the opposite side of the A4019, which would constitute a barrier to movement. Cumulative effects in relation to great crested newts are therefore not anticipated.

Overview

7.10.58. From a review of available information, the RFFPs relating to the non-strategic development sites and residual effects from the Scheme are considered unlikely to contribute to significant residual cumulative inter-project effects.

7.10.59. The precautionary approach adopted by the CEA recognises that there is potential for adverse additive cumulative inter-project effects for bats for all of the strategic development sites (the West Cheltenham Development Area, the safeguarded land to the north-west of Cheltenham and the North West Cheltenham Development Area); and for dormice in relation to the Scheme plus the North West Cheltenham Development Area and/or the safeguarded land to the north-west of Cheltenham. It is considered that these inter-project additive cumulative effects could be significant and mitigation is included within the Scheme, plus it is assumed that the developers will be required to adhere to all relevant environmental legislation in relation to the impacts of their proposals.

7.10.60. In addition to this, in the event that habitat loss associated with the Scheme and the strategic development sites were to occur at the same time, there is potential for significant cumulative effects as a result of limited habitat availability for any displaced species to move into. There is also potential for synergistic cumulative effects on various species (including bats, dormouse, other priority mammals, birds and reptiles) via reduced habitat connectivity, if the distribution of habitat provision delivered by each RFFP does not take the delivery timing and location of habitat provision associated with neighbouring development proposals into consideration. It is considered that these inter-project additive and in-combination effects could be significant and mitigation is included within the Scheme.

7.10.61. The Scheme includes commitment CEA2 within the REAC (Application document ~~TR010063 – App 7.4~~TR010063/APP/7.4), which is intended to secure the continued efficacy and realise long term benefits of the Scheme's environmental design in the context of strategic development sites, specifically to manage inter-project effects. The adverse effects could be significant; however, effective co-ordination between the Scheme promoter and developers (as advocated through CEA2) have the potential to manage these effects such that they would become non-significant. This should include carefully reviewing the timing and environmental design of all of these developments and ensuring a staggered approach and/or significant advance habitat creation, with due consideration of habitat connectivity, in order to avoid significant cumulative effects.

7.11. Assumptions and limitations

7.11.1. Feature-specific limitations are included in the relevant Technical Appendix reports Appendices 7.1 to 7.18 (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15). General limitations are included here.

7.11.2. 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.

7.11.3. 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.

7.11.4. Full access to the study area was not available for the field surveys, due to landowners refusing access. In these areas, the assessment has relied on desk study data, survey data from adjacent land parcels, where available, and professional judgement. Where high levels of uncertainty remain, the precautionary approach has been applied.

7.12. Chapter summary

7.12.1. Ecological baseline data associated with the Scheme has been gathered and information from desk study and field surveys has been used to identify and evaluate biodiversity resources to undertake an assessment of potential impacts for the Scheme.

7.12.2. The following important biodiversity resources have been identified:

- Wye Valley and the Forest of Dean Bat Sites SAC.
- Cotswold Beechwoods SAC.
- Walmore Common SPA/Ramsar.
- Severn Estuary SAC/SPA/Ramsar.
- Coombe Hill Canal SSSI.
- Non-statutory designated nature conservation sites.
- Terrestrial habitat – veteran trees.
- Terrestrial habitat - broadleaved semi-natural woodland / lowland mixed deciduous woodland priority habitat.

- Terrestrial habitat - traditional orchards at Millhouse Farm and Hayden Hill Fruit Farm and potentially present noble chafer population.
- Terrestrial habitat – Moat Lane habitat complex.
- Terrestrial habitat – B4634 habitat complex.
- Terrestrial habitat – unimproved neutral grassland / lowland meadow priority habitat.
- Terrestrial habitat – Stanboro Lane orchard habitat complex and potential noble chafer population.
- Terrestrial habitat – Hedgerows priority habitat.
- Terrestrial habitat – A4019 habitat complex.
- Terrestrial habitat – M5 Junction 10 and motorway embankments habitat complex.
- Bats.
- Dormouse.
- Otter.
- Other priority mammals.
- Wintering and breeding birds (excluding barn owl).
- Barn owl.
- Reptiles.
- Great crested newt.
- Common toad.
- ~~Terrestrial invertebrates.~~
- River Chelt.
- Leigh Brook.
- Other Ordinary Watercourses.
- Standing waterbodies.

7.12.3. Other terrestrial habitats, ~~INNS~~badger, terrestrial invertebrates (excluding noble chafer, considered as a potential feature of traditional orchards) and ~~badgers~~ INNS are considered to be of less than local value and as such are not considered to be important biodiversity resources. Although they are not included in the impact assessment, appropriate mitigation is included in this chapter where necessary to ensure legal compliance.

7.12.4. No impacts are anticipated on Wye Valley and Forest of Dean Bat Sites SAC, Walmore Common SPA/Ramsar, Cotswold Beechwoods SAC, Severn Estuary SPA, Coombe Hill Canal SSSI, non-statutory designated nature conservation sites, veteran trees, broadleaved semi-natural woodland / lowland mixed deciduous woodland priority habitat, traditional orchards at Millhouse Farm and Hayden Hill Fruit Farm and potentially present noble chafer population, Moat Lane habitat complex~~,~~ and B4634 habitat complex ~~and terrestrial invertebrates~~. Water vole, white-clawed crayfish and priority plants are considered to be absent and have been scoped out of the assessment.

7.12.5. Numerous potential impacts have been identified in relation to the remaining biodiversity resources, and a range of measures have been identified to avoid, mitigate and compensate for the effects of these impacts. These include design specifications and construction management requirements.

7.12.6. Taking into account the embedded and additional essential mitigation measures proposed, significant residual effects in relation to biodiversity resources are not anticipated as a result of the Scheme.

7.12.7. There is the potential for significant cumulative effects with the proposed larger schemes in the area, but this could be mitigated by ensuring a staggered approach and/or significant advance habitat creation, with due consideration of habitat connectivity, to ensure no significant loss of habitat / connecting habitat at the same time.

Summary of Biodiversity Net Gain assessment

7.12.8. The Scheme has the potential to achieve a net gain for terrestrial habitats, hedgerows, rivers and streams, and ditches within the Order limits, with the potential to achieve in excess of 10% for all elements.

7.12.9. A summary of the headline BNG results for the Scheme is provided in Table 7-18~~Table 7-18~~ below.

Table 7-18 - Summary of H~~h~~eadline R~~r~~esults from M~~m~~etric within the O~~o~~rder L~~l~~imits

	Total Habitat Units	Total Hedgerow Units	Total River Biodiversity Units (RBU) for River and Streams	Total RBUs for Ditches
Baseline	656.58	138.25	7.67	19.45
Post-development including retention and creation	732.69	160.32	10.30	23.99
Total net unit change	76.11	22.06	2.62	4.55
Total net percentage change (%)	**11.59%**	**15.96%**	**34.19%**	**23.38%**

Appendices

Appendix 7.1 – Phase 1 habitat survey

Appendix 7.1 – Phase 1 habitat survey is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Appendix 7.2 – Hedgerow survey

Appendix 7.2 – Hedgerow survey is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Appendix 7.3 – Bat survey

Appendix 7.3 – Bat survey is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Appendix 7.4 – Dormouse survey

Appendix 7.4 – Dormouse survey is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Appendix 7.5 – Badger survey

Appendix 7.5 – Badger survey is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Appendix 7.6 – Otter survey

Appendix 7.6 – Otter survey is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Appendix 7.7 – Water vole survey

Appendix 7.7 – Water vole survey is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Appendix 7.8 – Breeding birds survey

Appendix 7.8 – Breeding birds survey is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Appendix 7.9 – Wintering birds survey

Appendix 7.9 – Wintering bird is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Appendix 7.10 – Reptile survey

Appendix 7.10 – Reptile survey is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Appendix 7.11 – Great crested newt survey

Appendix 7.11 – Great crested newt survey is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Appendix 7.12 – Aquatic ecology survey

Appendix 7.12 – Aquatic ecology survey is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Appendix 7.13 – Habitats Regulations Assessment

Appendix 7.13 – Habitat Regulations Assessment is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Appendix 7.14 – Habitats Regulations Assessment – Statement to inform an Appropriate Assessment

Appendix 7.14 – Habitat Regulations Assessment – Statement to inform an Appropriate Assessment is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Appendix 7.15 – Bat Mitigation Strategy

Appendix 7.15 – Bat Mitigation Strategy is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Appendix 7.16 – Barn Owl Survey

Appendix 7.16 – Barn Owl is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Appendix 7.17 – Validation report

Appendix 7.17 – Validation report is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Appendix 7.18 – Biodiversity Net Gain

Appendix 7.18 – Biodiversity Net Gain report is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

Appendix 7.19 – Figures

Appendix 7.19 – Biodiversity Chapter Figures is provided as a separate document (~~application~~Application document ~~TR010063 – APP 6.15~~TR010063/APP/6.15).

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