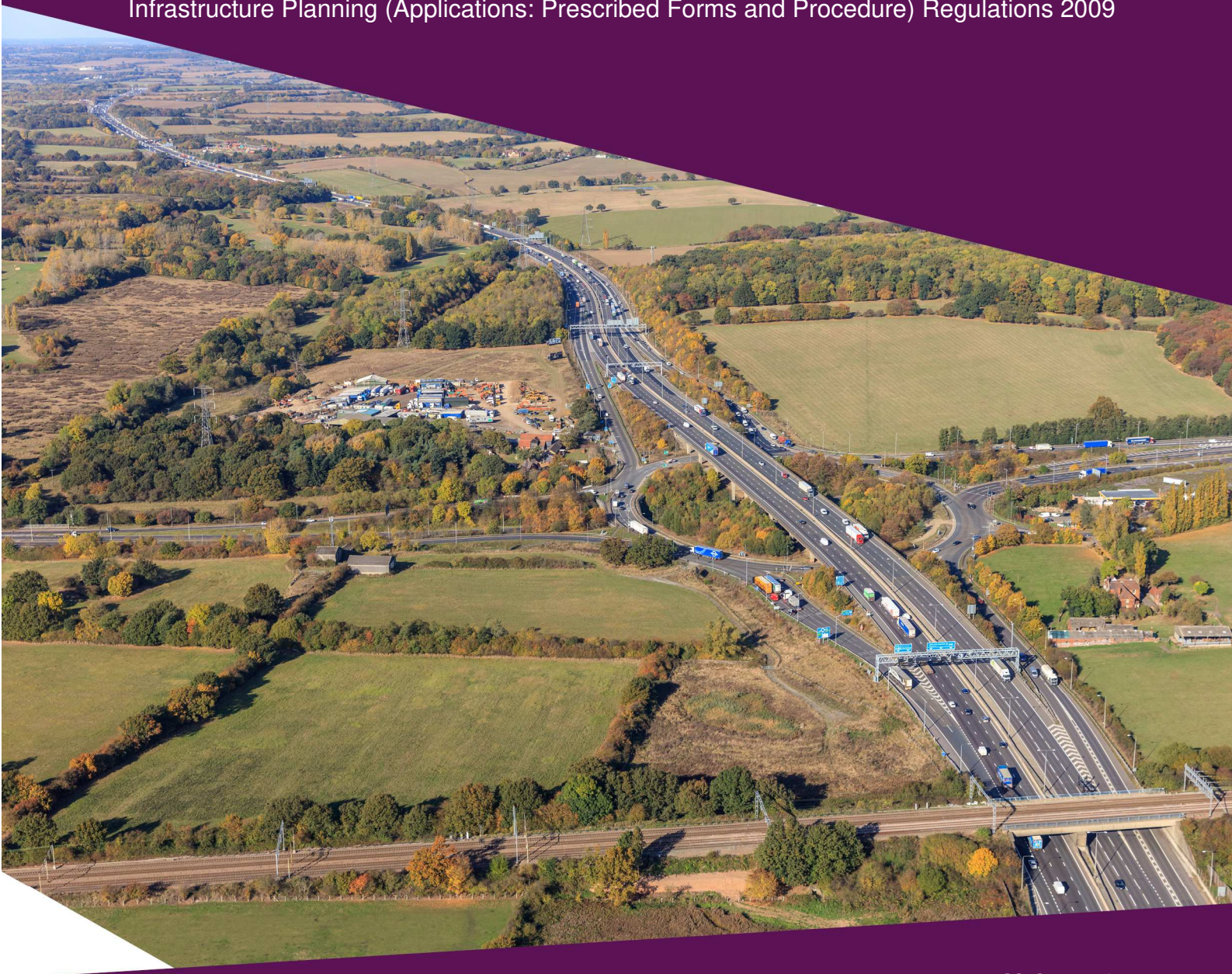
M25 Junction 28 improvement scheme
TR010029
6.1 Environmental Statement
Chapter 7: Biodiversity

APFP Regulation 5(2)(a)
Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009



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M25 junction 28 scheme
Development Consent Order 202[x]

6.1 ENVIRONMENTAL STATEMENT
CHAPTER 7: BIODIVERSITY

Regulation Number:	Regulation 5(2)(a)
Planning Inspectorate Scheme Reference:	TR010029
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Author:	M25 junction 28 improvement scheme project team, Highways England

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2	30 June 2021	Deadline 9, final version
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Executive summary

An assessment has been undertaken of the effect of the Scheme on biodiversity resources. This includes a description of the ecological baseline, evaluation of biodiversity features present and assessment of impacts and effects on important biodiversity resources (in line with relevant guidance).

Desk based and field survey work identified a number of important biodiversity resources within and adjacent to the Scheme.

The Scheme lies within the northern extent of Ingrebourne Valley Site of Metropolitan Importance for Nature Conservation (SMI). This large SMI covers the Ingrebourne River corridor and associated habitats through London Borough of Havering.

Construction of the Scheme would result in the permanent loss of habitat including 2 % of the total area of the Ingrebourne Valley SMI and the loss of two veteran trees. During construction, loss of habitat and disturbance of species has the potential to result in temporary adverse effects on Ingrebourne Valley SMI (approximately 9.4 % of the total area), Ingrebourne River, Weald Brook, great crested newts, bats, breeding birds, otter and terrestrial invertebrates.

To reduce these potential effects of the Scheme on biodiversity resources, mitigation and compensation measures have been incorporated into the design. These include, but are not limited to: protection of species during construction, appropriate reinstatement and creation of habitats within temporary construction areas and remodelling and enhancement of the Ingrebourne River and Weald Brook. When established, replacement habitats created during construction would be suitable to support a diverse range of species. All newly created habitats would be managed and monitored as part of a long-term management plan.

The location and design constraints of the Scheme (such as highways safety, structural stability, clearance from floodplain) would result in the unavoidable loss of habitats. Every effort has been made within the design to minimise this loss and retain important features, such as reducing the permanent footprint of the Scheme on the existing floodplain (by replacing embankments with retaining walls) and providing wide-span bridges over watercourses. Despite the mitigation and compensation proposals, the Scheme has the potential to result in the following residual effects:

- Adverse effect of moderate significance in relation to the loss of two veteran trees.
- Adverse effect of slight significance to Ingrebourne Valley SMI due to the permanent loss of 2 % of the SMI.
- Adverse effect of moderate significance on the Ingrebourne River within the DCO boundary due to the permanent loss of open water and riparian habitat caused by the 80 m culvert extension. Enhancement of riverine habitats outside the DCO boundary would result in a neutral effect on the Ingrebourne Water Framework Directive (WFD) waterbody (GB106037028130). However, the adverse effect on the Ingrebourne River within the DCO boundary remains.

No long-term residual effects are anticipated for great crested newts, bats, breeding birds, otter and terrestrial invertebrates.

7. Biodiversity

7.1 Introduction

7.1.1 This chapter assesses the effects of the Scheme on biodiversity resources. It has been prepared in accordance with good practice guidance for ecological impact assessment of road schemes including the Design Manual for Roads and Bridges (DMRB) Volume 10, Section 4, relating to Environmental Design and Management, DMRB Volume 11, Section 3, Part 4 relating to Ecology and Nature Conservation, IAN 130/10 Ecology and Nature Conservation: Criteria for Impact Assessment, and the Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment.

7.1.2 Desk study and field survey data were used to inform the detailed assessment of biodiversity resources that were considered likely to be affected by the Scheme. This chapter provides the ecological baseline, an evaluation of the biodiversity resources relevant to the Scheme and an assessment of the significant effects on those resources after mitigation, as a result of the Scheme.

7.1.3 A description of the Scheme is provided in the Scheme chapter (Chapter 2) of the ES (application document TR010029/APP/6.1). The assessment is based on baseline information available at preliminary design stage (see Scheme layout plans application document TR010029/APP/2.6).

7.1.4 The Scheme boundary is defined by the Development Consent Order (DCO) boundary shown on Figure 1.1 (application document TR010029/APP/6.2).

7.1.5 Survey information to support this chapter is provided in the following appendix documents referenced Appendix 7.1 to 7.16 listed below (application document TR010029/APP/6.3). These are referred to within the relevant sections of the chapter below:

- Appendix 7.1 Biodiversity legislation
- Appendix 7.2 Desk study report
- Appendix 7.3 Phase 1 Habitat survey
- Appendix 7.4 National vegetation classification survey
- Appendix 7.5 River corridor survey
- Appendix 7.6 Aquatic survey report
- Appendix 7.7 Arboricultural impact assessment
- Appendix 7.8 Invertebrate scoping survey
- Appendix 7.9 Great Crested Newt survey
- Appendix 7.10 Reptile survey
- Appendix 7.11 Breeding bird and barn owl survey
- Appendix 7.12 Bat survey
- Appendix 7.13 Dormouse survey
- Appendix 7.14 Badger survey (confidential)
- Appendix 7.15 Otter and water vole survey

- Appendix 7.16 Outline landscape and ecological management and monitoring plan

7.2 Competent expert evidence

7.2.1 This chapter has been written by a competent professional ecologist, who is a Chartered Ecologist and Full Member of the Chartered Institute for Ecology and Environmental Management (CIEEM), with 17 years' experience in ecology consultancy.

7.2.2 This chapter has been checked and updated by a professional ecologist, who is a full member of CIEEM with over 12 years' experience in ecology consultancy.

7.2.3 This chapter has been reviewed by a professional ecologist who is a full member of CIEEM and Chartered Environmentalist (CEnv) with over 20 years' experience in ecology consultancy.

7.2.4 All surveys have been led by ecologists who are considered to be competent. Appendices 7.3 to 7.15 contain details of the experience of the leads for each survey type.

7.3 Legislative and policy framework

7.3.1 The legislation and regulatory framework applicable to biodiversity is provided in the Biodiversity legislation document, Appendix 7.1. A summary of policy is provided in Table 7.1 below.

7.3.2 This chapter of the ES reports the findings of an assessment of the effects of the Scheme on biodiversity resources to support the DCO application by Highways England for the Scheme and has been prepared in accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the "EIA Regulations 2017"). See Environmental Assessment Methodology chapter (Chapter 4) of the ES for further details of the EIA process.

7.3.3 In order to understand the potential implications of the Scheme on European sites designated under the Conservation of Habitats and Species Regulations 2017, such as Special Areas of Conservation (SACs), Special Protection Areas (SPAs), and on Wetlands of International Importance (Ramsar sites), a Habitats Regulations Assessment (HRA) Stage 1 screening has been undertaken. This concluded that there are no likely significant effects on any European sites due to the fact that all European sites are sufficiently distant from the Scheme and that any potential impacts via hydrological pathways would be negligible. The results of this screening process have been reported in the HRA Stage 1 Screening (application document TR010029/APP/6.9).

Table 7.1: Summary of relevant biodiversity policy

Scale	Policy	Summary of requirements
European	Water Framework Directive (2000/60/EC)	The Water Framework Directive (WFD) aims to protect and enhance the quality of the water environment. The WFD requires all, natural surface waterbodies to achieve both Good Chemical Status and Good Ecological Status. Artificial and Heavily Modified Water Bodies may be prevented from reaching Good Ecological Status due to the modifications necessary to maintain their function, e.g. navigation. They are, however, required to achieve Good Ecological Potential,

Scale	Policy	Summary of requirements
		through the implementation of a series of mitigation measures. The WFD also requires good status (both qualitative and quantitative) to be achieved for all ground water bodies and the prevention of the deterioration in groundwater status. In addition, it requires the achievement of objectives and standards for protected areas; and the reversal of significant and sustained upward trends in pollutant concentrations in groundwater. Status is reported at the water body scale, with individual water bodies forming part of larger river basin districts (RBD), for which river basin management plans (RBMPs) have been developed. This RBMP is designed to protect and improve the quality of the water environment. It includes consideration of the following topics: • Plans for the protection and improvement of the water environment; • Future plans that may affect the infrastructure sector and its obligations; • Development proposal considerations regarding the requirements of the plan; and • Environmental permit applications The first RBMPs were published in 2009 followed by a Cycle 2 update published in 2016.
National	National Policy Statement for National Networks (NPS NN) 2014[1]	Chapter 3, 'Wider government policy on the national networks': • Paragraph 3.2 *The Government recognises that for development of the national road and rail networks to be sustainable these should be designed to minimise social and environmental impacts and improve quality of life.* • Paragraph 3.3 *In delivering new schemes, the Government expects applicants to avoid and mitigate environmental and social impacts in line with the principles set out in the National Planning Policy Framework and the Government's planning guidance. Applicants should also provide evidence that they have considered reasonable opportunities to deliver environmental and social benefits as part of schemes.* Chapter 4, 'Environmental Impact Assessment': • Paragraph 4.23 *Applicants are required to provide sufficient information with their applications for development consent to enable the Secretary of State to carry out an Appropriate Assessment if required. This information should include details of any measures that are proposed to minimise or avoid any likely significant effects on a European site. The information provided may also assist the Secretary of State in concluding that an Appropriate Assessment is not required because significant effects on European sites are sufficiently unlikely that they can be excluded.* • Paragraph 4.24 *If a proposed national network development makes it impossible to rule out an adverse effect on the integrity of a European site, it is possible to*

[1] Department for Transport (December 2014). National Policy Statement for National Networks.

Scale	Policy	Summary of requirements
		apply for derogation from the Habitats Directive, subject to the proposal meeting three tests. These tests are that no feasible, less-damaging alternatives should exist, that there are IRPOI for the proposal going ahead, and that adequate and timely compensation measures will be put in place to ensure the overall coherence of the network of protected sites is maintained. • Paragraph 4.25 *Where a development may negatively affect any priority habitat or priority species on a site for which they are a protected feature, any IROPI case would need to be established solely on one or more of the grounds relating to human health, public safety or beneficial consequences of primary importance to the environment.* Chapter 5, 'Biodiversity and ecological conservation': • Paragraph 5.27 *The most important sites for biodiversity are those identified through international conventions and European Directives. The Habitats Directive provides statutory protection for European Sites and equivalent policy protection is afforded to Ramsar sites[2] (relevant paragraphs also include 4.22-4.25 relating to Habitat Regulations Assessment).* • Paragraph 5.29 *Where a proposed development is likely to have an adverse effect on a Site of Special Scientific Interest (SSSI), development consent should not normally be granted. Where an adverse effect on a 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 wider network of SSSIs. The Secretary of State should ensure that the applicant's proposals to mitigate the harmful[3] aspects of the development and, where possible, to ensure the conservation and enhancement of the site's biodiversity or geological interest, are acceptable. Where necessary, requirements and/or planning obligations should be used to ensure these proposals are delivered.* • Paragraph 5.31 *Sites of regional and local biodiversity (which include Local Nature Reserves, Local Wildlife Sites and Nature Improvement Areas) have a fundamental role to play in meeting overall national biodiversity targets, in contributing to the quality of life and the well-being of the community, and in supporting research and education. The Secretary of State should give due consideration to such regional or local designations. However, given the need for new infrastructure, these designations should not be used in themselves to refuse development consent.* • Paragraph 5.32 *Ancient woodland is a valuable biodiversity resource both for its diversity of species and for its longevity as woodland. Once lost it cannot be recreated. The Secretary of State should not grant 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*

[2] Special Areas of Conservation and Special Protection Areas, as well as Sites of Community Importance, cSACs, pSPAs, Ramsars, pRamsars and sites identified, or required, as compensatory measures for adverse effects on any of these European Sites
[3] In line with the principle above, the term "harm" should be understood to mean significant harm.

Scale	Policy	Summary of requirements
		outside ancient woodland, unless the national need for and benefits of the development, in that location, clearly outweigh the loss. Aged or veteran trees found outside ancient woodland are also particularly valuable for biodiversity and their loss should be avoided[4]. Where such trees would be affected by development proposals, the applicant should set out proposals for their conservation or, where their loss is unavoidable, the reasons for this. • Paragraph 5.33 *Development proposals potentially provide many opportunities for building in beneficial biodiversity or geological features as part of good design[5]. When considering proposals, the Secretary of State should consider whether the applicant has maximised such opportunities in and around developments.* • Paragraph 5.35 *The Secretary of State should ensure that applicants have taken measures to ensure that statutory protected species[6] and species and habitats identified as being of principle importance for the conservation of biodiversity in England[7] species and habitats are protected from the adverse effects of development. Where appropriate, requirements or planning obligations may be used in order to deliver this protection. The Secretary of State should refuse consent where harm to the habitats or species and their habitats would result, unless the benefits of the development (including need) clearly outweigh that harm.* • Paragraph 5.36 *Applicants should include appropriate mitigation measures as an integral part of their proposed development, including identifying where and how these will be secured. In particular, the applicant should demonstrate that:* – *During construction, they will seek to ensure that activities will be confined to the minimum areas required for the works;* – *During construction and operation, best practice will be followed to ensure that risk of disturbance or damage to species or habitats is minimised (including as a consequence of transport access arrangements);* – *Habitats will, where practicable, be restored after construction works have finished;* – *Developments will be designed and landscaped to provide green corridors and minimise habitat fragmentation where reasonable; and* – *Opportunities will be taken to enhance existing habitats and, where practicable, to create new habitats of value within the site landscaping proposals, for example through techniques such as the 'greening' of existing network crossing points, the use of green bridges and the habitat improvement of the network verge.*

[4] This does not prevent the loss of such trees where the decision-maker is satisfied that their loss is unavoidable
[5] The Natural Environment White Paper 2011 identifies opportunities for transport to contribute to the creation of coherent and resilient ecological networks.
[6] Certain plant and animal species, including all wild birds, are protected under the Wildlife and Countryside Act 1981. European plant and animal species are protected under the Conservation of Habitats and Species Regulations 2017 (as amended). Some other animals are protected under their own legislation, for example Protection of Badgers Act 1992
[7] Lists of habitats and species of principal importance for the conservation of biological diversity in England published in response to Section 41 of the Natural Environment and Rural Communities Act 2006 are available from the Biodiversity Action Reporting System website.

Scale	Policy	Summary of requirements
		• Paragraph 5.37 *The Secretary of State should consider what appropriate requirements should be attached to any consent and/or in any planning obligations entered into in order to ensure that mitigation measures are delivered.* • Paragraph 5.38 *The Secretary of State will need to take account of what mitigation measures may have been agreed between the applicant and Natural England, and whether Natural England has granted or refused, or intends to grant or refuse, any relevant licences, including protected species mitigation licences.*
	National Policy Planning Framework (NPPF) 2019[8]	Chapter 15 of the NPPF 'Conserving and enhancing the natural environment': • Paragraph 170 *Planning policies and decisions should contribute to and enhance the natural and local environment by:* – *Protecting and enhancing valued landscapes, geological conservation interests and soils (in a manner commensurate with their statutory status or identified quality in the development plan);* – *Recognising the intrinsic character and beauty of the countryside, and the wider benefits from natural capital and ecosystem services – including the economic and other benefits of the best and most versatile agricultural land, and of trees and woodland;* – *Minimising impacts on and providing net gains for biodiversity, including by establishing including by establishing coherent ecological networks that are more resilient to current and future pressures;* – *Preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and* – *Remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.* • Paragraph 171 *Plans should: distinguish between the hierarchy of international, national and locally designated sites; allocate land with the least environmental or amenity value, where consistent with other policies in this Framework[9]; take a strategic approach to maintaining and enhancing networks of habitats and green infrastructure; and plan for the enhancement of natural capital at a catchment or landscape scale across local authority boundaries.* • Paragraph 174 *To protect and enhance biodiversity and geodiversity, plans should:* – *Identify, map and safeguard components of local wildlife-rich habitats and wider ecological networks,*

[8] Ministry of Housing, Communities and Local Government (February 2019) National Planning Policy Framework. Accessed at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/779764/NPPF_Feb_2019_web.pdf
[9] Where significant development of agricultural land is demonstrated to be necessary, areas of poorer quality should be preferred to those of a higher quality.

Scale	Policy	Summary of requirements
		including the hierarchy of international, national and locally designated sites of importance for biodiversity[10]; wildlife corridors and stepping stones that connect them; and areas identified by national and local partnership for habitat management, enhancement, restoration or creation[11]; and – *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.* • Paragraph 175 *When determining planning applications, local planning authorities should apply the following principles:* – *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;* – *Development on land within or outside a Site of Special Scientific Interest, and which is likely to have an adverse effect on it (either individually or in combination with other developments), should not normally be permitted. The only exception is where the benefits of the development in the location proposed clearly outweigh both its likely impact on the features of the site that make it of special scientific interest, and any broader impacts on the national network of Sites of Special Scientific Interest;* – *Development resulting in the loss or deterioration of irreplaceable habitats (such as ancient woodland and ancient or veteran trees) should be refused, unless there are wholly exceptional reasons[12] and a suitable compensation strategy exists; and* – *Development whose primary objective is to conserve or enhance biodiversity should be supported; while opportunities to incorporate biodiversity improvements in and around developments should be encouraged, especially where this can secure measurable net gains for biodiversity.* • Paragraph 176 *The following should be given the same protection as habitats sites:* – *Potential Special Protection Areas and possible Special Areas of Conservation;* – *Listed or proposed Ramsar sites[13]; and* – *Sites identified, or required, as compensatory measures for adverse effects on habitats sites, potential Special Protection Areas, possible Special Areas of Conservation, and listed or proposed Ramsar sites.*

[10] Circular 06/2005 provides further guidance in respect of statutory obligations for biodiversity and geological conservation and their impact within the planning system
[11] Where areas that are part of the Nature Recovery Network are identified in plans, it may be appropriate to specify the types of development that may be suitable within them.
[12] For example, infrastructure projects (including nationally significant infrastructure projects, orders under the Transport and Works Act and hybrid bills), where the public benefit would clearly outweigh the loss or deterioration of habitat
[13] Potential Special Protection Areas, possible Special Areas of Conservation and proposed Ramsar sites are sites on which Government has initiated public consultation on the scientific case for designation as a Special Protection Area, candidate Special Area of Conservation or Ramsar site.

Scale	Policy	Summary of requirements
		• Paragraph 177 *The presumption in favour of sustainable development does not apply where the plan or project is likely to have a significant effect on a habitats site (either alone or in combination with other plans or projects), unless an appropriate assessment has concluded that the plan or project will not adversely affect the integrity of the habitats site.*
	Defra 25 Year Environment Plan 2018[14]	Sets goals for improving the environment within a generation and leaving it in a better condition than its current state. There are a number of goals and targets, but the following targets are of particular relevance to biodiversity: • Restoring 75% of our one million hectares of terrestrial and freshwater protected sites to favourable condition, securing their wildlife value for the long term; • Creating or restoring 500,000 hectares of wildlife-rich habitat outside the protected site network, focusing on priority habitats as part of a wider set of land management changes providing extensive benefits; • Taking action to recover threatened, iconic or economically important species of animals, plants and fungi, and where possible to prevent human induced extinction or loss of known threatened species in England and the Overseas Territories; • Increasing woodland in England in line with our aspiration of 12% cover by 2060: this would involve planting 180,000 hectares by end of 2042; and Managing and reducing the impact of existing plant and animal diseases; lowering the risk of new ones and tackling invasive non-native species.
	Department for Transport Road Investment Strategy (RIS) 2015 – 2020[15]	Section 6 includes aspirations by 2040 to have improved environmental outcomes, including a net gain in biodiversity from the Company's (Highways England) activities. In Section 7, one of the key performance indicators is "*delivering better environmental outcomes*". Investments made to achieve ambitions include the setting up of an Environment Fund to improve and halt the loss of local biodiversity. Areas targeted for the Environment Fund: • Increasing the number of SSSIs in good or recovering condition. • Interventions to support Nature Improvement Areas. One of the Key Performance Indicators (KPI) is Biodiversity: Delivery of improved biodiversity, as set out in the Company's Biodiversity Action Plan[16].
	Department for Transport RIS2 2020 – 2025[17]	Section 2 includes actions relating to improving the environment which include: • "On biodiversity, ensure no net loss across Highways England's activities in RP2[18] and continue progress

[14] Defra (2018) A Green Future: Our 25 Year Plan to Improve the Environment. This can be accessed at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/693158/25-year-environment-plan.pdf (Last Accessed 21/01/2019)
[15] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/408514/ris-for-2015-16-road-period-web-version.pdf
[16] Highways England (2014) Our plan to protect and enhance biodiversity.
[17] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/872252/road-investment-strategy-2-2020-2025.pdf
[18] Second Road Period (RP2) of RIS, covering the financial years 2020/21 to 2024/25.

Scale	Policy	Summary of requirements
		towards the target of delivering a net gain in biodiversity by 2040. New planting will be appropriate to local habitats." This action is listed as a KPI for RIS2 as follows: • Target: "Achieve No Net Loss of biodiversity over the whole Highways England soft estate by the end of RP2" Ring-fenced investment funds have been included to help deliver against environmental targets.
	Highways England: Strategic Business Plan 2015 to 2020	A commitment to continue to "manage land immediately surrounding the network to improve biodiversity". Delivering better environmental outcomes: • KPI: Delivery of improved biodiversity, as set out in the Company's Biodiversity Action Plan[16]. Target: The Company should publish its Biodiversity Action Plan by 30 June 2015 (published), and report annually on how it has delivered against the Plan to reduce net biodiversity loss on an ongoing annual basis.
	Highways England's Biodiversity Plan[16]	Proposes a local approach to improving biodiversity surrounding the road network and encourages management activities to be guided by the principles of Natural England's The Mosaic Approach: Managing Habitats for Species[19], including efforts to target priority habitats and species[20]. The Biodiversity Plan includes five outcomes. The following actions are taken from Outcome 3: We have delivered biodiversity enhancements whist implementing a capital programme of network improvement: • As part of normal delivery, network improvement projects will mitigate and compensate their biodiversity impacts in order achieve no net loss of biodiversity, as far as the projects are reasonably able. In addition, projects will identify biodiversity opportunities and deliver actions that will achieve net biodiversity gain, wherever possible • Project teams to liaise with local wildlife partners as part of their project design and development to identify how the project could best contribute towards landscape-scale biodiversity gains. Information on these opportunities to be provided to the relevant regional programme board and technical working group. In addition, the Road Investment Strategy[21] has sustainable aspirations for a net gain in biodiversity from the Company's activities.
Regional	The London Plan (2016)	Policy 7.19 (Biodiversity and access to nature) The London Plan states the Mayor's desire to 'work with all relevant partners to ensure a proactive approach to the protection, enhancement, creation, promotion and management of biodiversity in support of the Mayor's Biodiversity Strategy'. Therefore, proposals should make a 'positive contribution to the protection, enhancement, creation and management of biodiversity'. Furthermore, proposals should 'give the highest protection to sites with existing or proposed international designations (SACs,

[19] http://publications.naturalengland.org.uk/publication/6415972705501184
[20] Habitats and species of principal importance for the conservation of biodiversity as identified by the Secretary of State for England, in consultation with Natural England, are referred to in Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 for England.
[21] Department for Transport (2015) Road Investment Strategy: for the 2015/16-2019/20 Road Period.

Scale	Policy	Summary of requirements
		Special Protection Areas (SPAs), [Wetlands of International Importance] (Ramsar sites) and national designations (Sites of Specific Scientific Interest (SSSIs) and National Nature Reserves (NNNR).' Development proposals should give strong protection to sites of metropolitan importance for nature conservation (SMIs). These are sites jointly identified by the Mayor and boroughs as having strategic nature conservation importance. expects Development proposals should give sites of borough and local importance the level of protection that is commensurate with their importance Policy 7.21 (Trees and Woodland) seeks to retain existing trees of value and any loss should be replaced.
	Draft New London Plan (2019)[22]	Policy G6 states: Where harm to a SINC is unavoidable, and where the benefits of the development proposal clearly outweigh the impacts on biodiversity, the following mitigation hierarchy should be applied to minimise development impacts: • avoid damaging the significant ecological features of the site • minimise the overall spatial impact and mitigate it by improving the quality of management of the rest of the site • delivery off-site compensation of better biodiversity value.
	London Mayors Biodiversity Strategy	The London Mayor's Biodiversity Strategy (2002) sets out the policies that are necessary to ensure the conservation of London's natural environment and improve the ecology of the city. The objective of the strategy is to promote the conservation of biodiversity, by providing direction to London authorities to: • Establish a network of Sites of National Conservation (SINCs); • Support and encourage boroughs, land-owners and Londoners to take practical actions to improve the ecology of land they own or manage, including private gardens; • Use the planning system to green the urban environment through the installation of green roofs, planting of street trees and restoring rivers; and • Create more semi-natural green spaces to increase habitat for wildlife and provide Londoners with better access to nature.
Local	London Borough of Havering Core Strategy 2008	Policy CP16 protects and enhances the borough's *'rich biodiversity and geodiversity, in particular, priority habitats, species and sites'.* Policy DC58 reinforces the protection of SSSIs, and all sites of Metropolitan, Borough or Local Importance for Nature Conservation', with the remit of refusing consent for proposals that adversely affect those designations unless *'the economic or social benefits of the proposals clearly outweigh the nature conservation importance of the site'.* Even than adequate mitigation must be provided and it must be demonstrated that no alternative site is available.

[22] On the 9 December 2019, the London Mayor issued to the Secretary of State the intension to publish the London Plan along with a clean and tracked version of the Intend to Publish London Plan. This plan is available here; https://www.london.gov.uk/sites/default/files/intend_to_publish_-_clean.pdf [accessed December 2019].

Scale	Policy	Summary of requirements
		Under Policy DC59 enhancements to biodiversity and geodiversity will be sought, in line with London and Havering Biodiversity Action Plan targets, as an integral part of new development. Policy DC60 outlines the 'amenity and biodiversity value afforded by trees and woodland'. The policy states that trees and woodland will be protected and improved by: • Where appropriate, retaining trees of nature conservation and amenity value and making tree preservation orders; • Ensuring that adequate measures are put in place when granting planning permission to protect trees during construction works; • Supporting the implementation of the Thames Chase Plan and ensuring that, development within the area makes a positive contribution towards its implementation; and • Not granting planning permission for development that would adversely affect ancient and secondary woodland.
	Brentwood Replacement Local Plan (2005)	Policy C3 concerns '[*Local] Wildlife Sites (LWSs), LNRs and Other Habitats and Natural Features of Local Value'*. Specifically, the policy states that development which would have an *'unacceptable detrimental impact'* upon any site listed previously *'will not be permitted unless it can be clearly demonstrated that there are reasons for the proposal which outweigh the need to safeguard the substantive nature conservation value of the site or feature'.* Furthermore, *'appropriate mitigation and compensatory measures'* should be provided where appropriate. Policy C4 states the need for development to retain existing woodlands with management *'appropriate to age, use, location and scientific interest'.* Furthermore, the policy goes on to outline the need for the *'visual amenity, historical and ecological values of the woodland are safeguarded, and, where possible, enhanced'.* Policy C5 outlines the need for new development to allow for the retention of 'existing trees, hedges, woods, ponds, watercourses and other natural features'. Furthermore, development schemes must be accompanied by a site survey showing the existing landscape; a plan showing all existing trees; proposals for new tree planting; and a method statement for arboricultural work within the Scheme. Policy C7 states that development which would 'damage, destroy or threaten the future survival of trees protected by a tree preservation order, or trees within an area identified as ancient woodland or in a conservation area will not be permitted unless the removal of the tree would be in the interests of good arboricultural / silvicultural practice or the development clearly outweighs the amenity and/or nature conservation value of the tree'.
	London Borough Havering Local Development Framework	Policy DC 58 (biodiversity and geodiversity): Biodiversity and geodiversity will be protected and enhanced throughout the borough by: • protecting and enhancing Sites of Special Scientific Interest, and all sites of Metropolitan, Borough or Local Importance for Nature Conservation as identified in

Scale	Policy	Summary of requirements
		Protecting the Borough's Biodiversity SPD, and shown on the Proposals Map. Planning permission for development that adversely affects any of these sites will not be granted unless the economic or social benefits of the proposals clearly outweigh the nature conservation importance of the site and only then if adequate mitigation can be provided and no alternative site is available • not granting planning permissions which would adversely affect priority species/habitats identified in either the London or Havering Biodiversity Action Plans unless the economic or social benefits of the proposals clearly outweigh the nature conservation importance of the site and only then if adequate mitigation measures to secure the protection of the species/habitat can be provided and no alternative site is available • protecting and promoting the linking of habitats via the wildlife corridors • protecting and enhancing the biodiversity of the Blue Ribbon Network including rivers and their associated corridors. Policy DC59 (biodiversity in new developments): Enhancements to biodiversity and geodiversity will be sought, in line with London and Havering Biodiversity Action Plan targets, as an integral part of new development. Supplementary Planning Document 'Protecting and Enhancing the Borough's (adopted May 2009)[23] sets out key issues relating to consideration of biodiversity within the planning framework including: maintaining and enhancing biodiversity; protecting existing habitats and species; appropriate development design and climate change.
	Havering Nature Conservation and Biodiversity Strategy 2013[24]	Replaces the Havering Biodiversity Action Plan (2003). Sets out 18 objectives relating to nature conservation and an action plan to address these.

7.4 Study area

7.4.1 The study area for the assessment in relation to biodiversity resources has been identified by determining the predicted Ecological Zone of Influence (EZoI) encompassing all the predicted impacts and potentially adverse effects of the Scheme on biodiversity resources.

7.4.2 The initial extent of the EZoI is based on information provided in the preliminary design stage (shown on the Scheme layout plans (application document TR010029/APP/2.6), which includes activities associated with the construction and operation of the Scheme, and a review of aerial images and Ordnance Survey mapping to understand the composition of the landscape surrounding the Scheme.

7.4.3 The initial EZoI was used to inform the extent of the field surveys. The geographical area for obtaining ecological data through desk study has been

[23] https://www3.havering.gov.uk/Documents/Planning/LDF/Protecting-Enhancing-Boroughs-Biodiversity-SPD.pdf
[24] https://www3.havering.gov.uk/Documents/Leisure-parks-and-libraries/Open-spaces/nature-conservation-biodiversity-strategy.pdf

extended from the DCO boundary to obtain information on biodiversity resources at different spatial extents, as follows[25]:

- 30 km for SACs where bats are one of the qualifying species[26].
- 2 km for other statutory designated sites: other SACs, SPAs, Ramsar sites, Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs) and Local Nature Reserves (LNRs)[27]. This includes statutory designated sites within 200 m of the Affected Road Network (see Air Quality Assessment, Chapter 5 for further information regarding the Affected Road Network[28]).
- 2 km for non-statutory designated sites (including locally designated Sites of Importance for Nature Conservation (SINCs)[29] in Greater London and Local Wildlife Sites (LoWS) in Essex), and Ancient Woodland.
- 1 km for priority habitats[30]
- 5 km for records of bat roosts outside SACs[31].
- 500 m for waterbodies that may potentially be used as breeding ponds by great crested newts[32].
- 50 m for standing waterbodies (ponds and lakes).
- 2 km for priority[33] or legally protected species, and invasive species.
- 50 m for ancient or veteran trees[34].
- 2 km for watercourses and hydrologically connected waterbodies.

7.4.4 The field survey study area for the extended Phase 1 habitat survey included all land the DCO boundary where safe access was possible. This was extended into adjacent land up to 50 m from the DCO boundary where access permission had been granted.

[25] http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/11s3p04.pdf 'The physical scope of an assessment will vary according to the nature of each individual scheme. The area to be considered may need to extend beyond the study area in order to encompass all significant impacts

[26] As recommended in Department for Transport LA 115 Habitat Regulations Assessment http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section4/LA%20115%20Habitats%20Regulations%20assessment%20-web.pdf (paragraph 3.7)

[27] Including candidate SACs (cSACs), proposed SPAs (pSPAs), proposed Ramsar sites (pRamsars)

[28] The ARN for the Scheme does not extend beyond the DCO boundary

[29] SINCs in Greater London are classified into four categories: Sites of Metropolitan Importance (SMI); Sites of Borough Importance Grade 1 (SBI Grade 1); Sites of Borough Importance Grade 2 (SBI Grade 2); and Sites of Local Importance (SLI).

[30] [30] Priority habitats are those determined as Habitats of Principal Importance (HPI), listed under Section 41 of the NERC Act (2000), or habitats listed under local BAPs. London, Essex and LB Havering no longer have BAPs, but the priority species and habitats listed in the previous BAPs are considered as important in this assessment. A list of these species is taken from the following resources: London (https://www.gigl.org.uk/londons-biodiversity-action-plan/ [last accessed January 2020]), LB Havering (https://www3.havering.gov.uk/Documents/Leisure-parks-and-libraries/Open-spaces/nature-conservation-biodiversity-14-16.pdf [last accessed January 2020]) and Essex (http://www.essexfieldclub.org.uk/portal/p/Essex+BAP+species [last accessed January 2020]).

[31] Bat Conservation Trust *Good Practice Guidelines 3rd Edition* recommends that as a minimum background searches should be carried out up to 2 km from the site boundary. For larger schemes with a potentially greater EZoI the search area should be extended up to 10 km from the site boundary where statutory designated sites such as SACs or SSSIs relevant to bats are present depending on the scale of potential impacts. Due to the localised nature of the Scheme, and the main works for the Scheme being bound by the M25 to the east and A12 to the south, a search area of 5 km is considered sufficient for the Scheme: Collins, J (ed) (2016) *Bat Surveys for Professional Ecologists: Good Practice Guidelines* (3rd edn). The Bat Conservation Trust. London.

[32] Great crested newts can disperse up to 500m from a pond. Therefore, water bodies within 500m of the Scheme have been considered for their great crested newt potential.

[33] Priority species are those determined as Species of Principal Importance (SPI), listed under Section 41 of the NERC Act (2006); any species listed in an IUCN Red Data Book; Amber and Red-listed bird species, and any other species listed under a local Biodiversity Action Plans (BAP).), or as national or county rare or scarce. London, Essex and LB Havering no longer have BAPs, but the priority species and habitats listed in the previous BAPs are considered as important in this assessment. A list of these species is taken from the following resources: London (https://www.gigl.org.uk/londons-biodiversity-action-plan/ [last accessed January 2020]), LB Havering (https://www3.havering.gov.uk/Documents/Leisure-parks-and-libraries/Open-spaces/nature-conservation-biodiversity-14-16.pdf [last accessed January 2020]) and Essex (http://www.essexfieldclub.org.uk/portal/p/Essex+BAP+species [last accessed January 2020]).

[34] Veteran trees are defined in Appendix 7.7, Arboricultural Impact Assessment.

7.4.5 The detailed (phase 2) survey work for habitats and species has focussed on the initial EZoI. This relates to impacts identified in relation to construction and operation of the Scheme as set out on in Scheme description, Chapter 2 of the ES and associated Works plans (application document TR010029/APP/2.3). For this reason, the field survey study area for phase 2 surveys was focused on the land northwest of M25 junction 28, where the new loop road will be constructed, and the land south of the A12 (west of M25 junction 28) where there are temporary works associated with the gas main diversion. All other works within the DCO boundary are limited to the existing carriageway of the A12 and M25 (e.g. replacement of signs on existing gantries). Where no construction works or very minor construction works (such as sign replacements) are proposed within an area of the DCO boundary, and no potential impacts have been identified, it has not been necessary to carry out detailed phase 2 surveys.

7.4.6 The extent of the initial EZoI for the field survey was reviewed and re-defined prior to the assessment of potential impacts based on the results of the desk study and field surveys, and the refined design. The EZoI used for the impact assessment is described as the Final EZoI (see section 7.8).

7.5 Assessment methodology

7.5.1 The following section summarises the methodologies of the various ecological surveys undertaken within the study area.

Desk study

7.5.2 In May 2017 and September 2019, ecological records were obtained from Greenspace Information for Greater London (GiGL), Essex Field Club (EFC), and Essex Wildlife Trust (EWT). These included the following information:

- Records of non-statutory designated sites, including locally designated SINCs[35] in Greater London and LoWS in Essex.
- Records of priority[36] and legally protected[37] species (fauna and flora).
- Records of invasive plant species listed under Schedule 9 of the Wildlife and Countryside Act 1981 (as amended), or London Invasive Species Initiative (LISI) Species of Concern.

7.5.3 Following comments made by the London Borough of Havering and Essex County Council in response to public consultation on the Scheme, desk study records were requested from Essex Bat Group in May 2019 in relation to a bat survey project undertaken at Weald Country Park. Weald Country Park is located 1.3 km to the northeast of M25 J28.

7.5.4 The Multi-Agency Geographic Information for the Countryside (MAGIC) website[38] was reviewed for information on designated sites of nature conservation importance (statutory sites only). These included:

[35] SINCs in Greater London are classified into four categories: Sites of Metropolitan Importance (SMI); Sites of Borough Importance Grade 1 (SBI Grade 1); Sites of Borough Importance Grade 2 (SBI Grade 2); and Sites of Local Importance (SLI).
[36] Priority species are those determined as Species of Principal Importance (SPI), listed under Section 41 of the NERC Act (2006); any species listed in an IUCN Red Data Book; Amber and Red-listed bird species, and any other species listed under a local Biodiversity Action Plans (BAP).), or as national or county rare or scarce. London, Essex and LB Havering no longer have BAPs, but the priority species and habitats listed in the previous BAPs are considered as important in this assessment. A list of these species is taken from the following resources: London (https://www.gigl.org.uk/londons-biodiversity-action-plan/ [last accessed January 2020]), LB Havering (https://www3.havering.gov.uk/Documents/Leisure-parks-and-libraries/Open-spaces/nature-conservation-biodiversity-14-16.pdf [last accessed January 2020]) and Essex (http://www.essexfieldclub.org.uk/portal/p/Essex+BAP+species [last accessed January 2020]).
[37] Legally protected under wildlife legislation summarised in Appendix 7.1.
[38] http://www.magic.gov.uk/MagicMap.aspx [accessed September 2019]

- Internationally designated SACs, SPAs, and Ramsar sites
- Nationally designated SSSI and NNR
- Locally designated LNRs

7.5.5 MAGIC was also used to identify priority habitats[39] and Ancient Woodland. The Woodland Trust website[40] was used to identify veteran trees listed on their Ancient Tree inventory.

7.5.6 Ordnance Survey (OS) maps were used to initially identify the presence of water bodies within 250 m of the Scheme, for confirmation during field surveys, in order to establish if the land within and immediately surrounding the Scheme could be used as terrestrial habitat for great crested newts. Great crested newt typically use suitable terrestrial habitat up to 500 m from a breeding pond. However, there is a notable decrease in great crested newt abundance beyond a distance of 250 m from a breeding pond[41]. Therefore, taking into account the localised nature and potential impacts of the Scheme, and the presence of the M25 and A12 corridors, a distance of 250 m from the Scheme was used in the initial scoping assessment.

7.5.7 The London Borough of Havering Nature Conservation and Biodiversity Strategy[42] and Essex Biodiversity Action Plan (BAP)[43] were reviewed for details of priority habitats and species that may potentially be affected by the Scheme. A review of local planning policy relevant to the Scheme (see section 7.3) was also undertaken as part of the desk study.

7.5.8 Environment Agency aquatic ecology and watercourse habitat data was reviewed, including the Thames river basin district River Basin Management Plan (RBMP), freshwater biological survey data for macroinvertebrates, fish, macrophytes and phytobenthos[44] and River Habitat Survey (RHS).

Field survey

Preliminary ecological appraisal - extended Phase 1 habitat survey

7.5.9 An extended Phase 1 habitat survey was undertaken in June 2017 following Phase 1 habitat survey methodology as set out in the Joint Nature Conservation Committee (JNCC) guidance[45] to record information on the habitats within the study area, and was 'extended' to include a search for evidence of presence, and an assessment of the potential of each habitat to support, priority and legally

[39] Priority habitats are those determined as Habitats of Principal Importance (HPI), listed under Section 41 of the NERC Act (2000), or habitats listed under local BAPs. London, Essex and LB Havering no longer have BAPs, but the priority species and habitats listed in the previous BAPs are considered as important in this assessment. A list of these species is taken from the following resources: London (https://www.gigl.org.uk/londons-biodiversity-action-plan/ [last accessed January 2020]), LB Havering (https://www3.havering.gov.uk/Documents/Leisure-parks-and-libraries/Open-spaces/nature-conservation-biodiversity-14-16.pdf [last accessed January 2020]) and Essex (http://www.essexfieldclub.org.uk/portal/p/Essex+BAP+species [last accessed January 2020]).
[40] https://ati.woodlandtrust.org.uk
[41] Cresswell, W. & Whitworth, R. (2004) English Nature Research Reports Number 576: An assessment of the efficiency of capture techniques and the value of different habitats for the great crested newt *Triturus cristatus*. English Nature, Peterborough.
[42] The London Borough of Havering Biodiversity Action Plan is no longer in circulation. The replacement Nature Conservation and Biodiversity Strategy is available here: https://www3.havering.gov.uk/Documents/Leisure-parks-and-libraries/Open-spaces/nature-conservation-biodiversity-strategy.pdf [accessed Oct 2019]
[43] Essex County Council, (1999), A Wild Future for Essex.
[44] Phytobenthos are vascular plants, heterotrophic organisms and photosynthetic algae (including cyanobacteria) living on or attached to substrate or other organisms in surface waters
[45] Joint Nature Conservation Committee (2010) Handbook for Phase 1 habitat survey - a technique for environmental audit.

protected species as recommended by CIEEM[46]. Habitats were described and mapped based on the JNCC guidance[47].

7.5.10 The findings of the extended Phase 1 habitat survey in 2017 were used to inform the requirement for any detailed 'phase 2' habitat and species surveys in 2017 and early 2018. Guidance from CIEEM[48] indicates that where survey data is 18 months to 3 years old '*A professional ecologist will need to undertake a site visit and may also need to update desk study information'* but also indicates that the potential for mobile species, changes in conditions and local context should be taken into account when determining the requirement for further survey.

7.5.11 The extended Phase 1 habitat survey was updated in 2019 to include areas added to the DCO boundary south of the A12, and to update the survey of the rest of the land within the DCO boundary to check for any changes to the habitats recorded and to identify and additional potential impacts or new biodiversity resources. No significant changes to habitats and conditions in the study area were recorded. Updates to phase 2 surveys were only proposed in 2019 where additional information was required for gap filling (e.g. surveys for roosting bats, update check for badger setts and additional scoping for terrestrial invertebrates). Taking into account the results of the surveys and current conditions in the field survey study area, the findings of the 2017 and 2018 surveys for habitats (National Vegetation Classification) and other species were considered sufficient to inform the impact assessment of the Scheme (see Assumptions and Limitations, section 7.4 below).

7.5.12 Updated surveys for some priority and protected species will be required prior to construction which is standard practice to inform requirements prior to and throughout construction where there is a gap in time between assessment and commencement of construction. Where such surveys would be required, they are listed in the Outline Construction Environmental Management Plan (CEMP) (application document TR010029/APP/7.2).

7.5.13 Further details of the phase 1 habitat survey methodology, a description of habitats and the habitat maps are provided in the Phase 1 Habitat Survey, Appendix 7.3.

National Vegetation Classification (NVC) survey

7.5.14 A detailed vegetation survey of potentially important habitats within the DCO boundary was carried out during August 2017. The survey focussed on habitats potentially directly affected by the Scheme. These habitats included semi-improved neutral grassland at three locations: grassland north of Grove Farm and south of Alder Wood; a woodland ride between Weald Brook and Alder Wood in the northern extent of the DCO boundary; and grassland west of Weald Brook. Two woodlands were also surveyed: Alder Wood and The Grove. Reference was made to guidelines published in the National Vegetation Classification, User's handbook[49]. Plant names recorded during the survey and used in this chapter follow *The New Flora of the British Isles*, Fourth Edition[50].

[46] At the time of the survey in June 2017, the following guidelines were available: Chartered Institute of Ecology and Environmental Management (2012). Guidelines for Preliminary Ecological Assessment. In December 2017, a second edition of the guidelines was issued. The survey work carried out in June 2017 and in subsequent surveys at the site followed the guidance provided in the Second Edition.
[48] https://cieem.net/wp-content/uploads/2019/04/Advice-Note.pdf
[48] https://cieem.net/wp-content/uploads/2019/04/Advice-Note.pdf
[49] Rodwell, J.S. (2006) NVC Users' Handbook, JNCC, Peterborough
[50] Stace, C. (2019) New Flora of the British Isles. Forth Edition. C&M Floristics, Suffolk.

7.5.15 The NVC uses different sized quadrats depending on the type of vegetation to be sampled. The grassland was sampled using standard plots of 2 m x 2 m and woodland used two quadrats types: a 50 m x 50 m quadrat to assess the canopy and within that area, two 4 m x 4 m quadrats taken to assess the ground flora. Typically, five sets of quadrats were used within each location identified above, so that 15 quadrats were used in total to identify the species within the grassland and 10 (large) and 20 (smaller) quadrats were used to identify the species within the woodlands.

7.5.16 Further detail of the survey methodology and plans of the field survey study area are provided in National Vegetation Classification Survey, Appendix 7.4.

Watercourses and standing waterbody surveys

Habitat surveys

7.5.17 A River Corridor Survey (RCS) was undertaken on the Weald Brook and Ingrebourne River in November 2017, as per the methods in the National Rivers Authority "River Corridor Surveys – Technical Handbook No 1"[51]. Three 500 m reaches were surveyed on the Weald Brook. Only 270 m of the Ingrebourne River was surveyed between the culvert beneath the M25 and the confluence with the Weald Brook. The survey methodology is a habitat-based approach, recording details of dominant vegetation types and physical habitat character within the reach, it does not provide a comprehensive species account. This information is gathered and recorded in the form of a map using a set of standard symbols and abbreviations.

7.5.18 Further details of the survey methodology and a map of the reaches surveyed for the Scheme are shown in the River Corridor Survey provided as Appendix 7.5.

Aquatic macroinvertebrate surveys

7.5.19 Aquatic macroinvertebrate surveys were undertaken on the Weald Brook and Ingrebourne River in September 2017. The survey locations are provided in Table 7.2.

Table 7.2: Aquatic macroinvertebrate survey locations

Site / watercourse name	Aquatic macroinvertebrate survey location (NGR)	Distances from proposed works
Ingrebourne River	TQ 56500 92210	Within the DCO boundary: • In the section of the river proposed to be re-aligned.
Weald Brook	TQ 56370 92290	Within the DCO boundary: • 260 m south of the proposed northern loop road crossing the brook; and • 150 m north of the proposed southern crossing point.

7.5.20 The method used to sample invertebrates followed the standard four-minute combined kick-sampling technique, adhering to Environment Agency

[51] NRA Technical Handbook 1 - River Corridor Surveys. (1991). National Rivers Authority.

guidelines[52]. The surveys were undertaken by two people at all times for safety reasons. In summary, the sampling methodology comprised:

- Thirty seconds of netting of any surface-active insects, such as pond skaters and whirligig beetles.
- Three minutes of active kicking and disturbing substrates and sediment with additional sweeping of vegetation where present.
- Thirty seconds of hand searching for invertebrates, such as those adhering to submerged logs, stones or other debris, for example leeches and caddisfly larvae.

7.5.21 Care was taken to ensure that all habitats and micro-habitats, both typical and atypical, were proportionally represented in the sample, and that surface-active insects and species adhered to submerged logs and stones were included.

7.5.22 Samples were preserved in methylated spirits and stored at a laboratory. After the samples were sorted, the recovered macroinvertebrates were identified to family level, and the relative abundance of each taxon was recorded.

7.5.23 Further detail of the survey methodology is provided in the Aquatic Survey Report, Appendix 7.6.

Electrofishing surveys

7.5.24 Two sites, one on each of the Weald Brook and Ingrebourne River, were surveyed for fish. The locations were selected following a reconnaissance visit undertaken on 23 August 2017. Surveys were undertaken in accordance with Environment Agency guidelines[53]. The survey site locations are provided in Table 7.3.

Table 7.3: Electrofishing survey locations

Site / watercourse name	Upstream limit of the electrofishing survey (NGR)	Downstream limit of the electrofishing survey (NGR)	Distances from proposed works
Ingrebourne River	TQ 56595 92313	TQ 56509 92260	Within the DCO boundary: • In the section of the river proposed to be re-aligned.
Weald Brook	TQ 56323 92421	TQ 56360 92331	Within the DCO boundary: • 260 m south of the proposed northern loop road crossing the brook; and • 150 m north of the proposed southern crossing point.

7.5.25 Stop nets were positioned at the upstream and downstream limits of each survey. Electrofishing involved a three-catch removal method, in which each of the three electro-fishing 'runs' ran downstream to upstream. All fish captured on each run were transferred to water-filled buckets until the surveys were completed on a site-by-site basis. Between each run, time was allowed for the water to clear following disturbance of the substrate.

[52] Environment Agency (1999). Procedures for collecting and analysing macroinvertebrate samples.
[53] Environment Agency (2010) Electric fishing in rivers. Operational Instruction 144_03

7.5.26 Upon completion of surveys at each site, the fish were identified to species level, measured (fork length or total length to the nearest mm depending on the species), and counted, before being released back into the site from which they were captured.

7.5.27 The physical characteristics of the watercourses were recorded during the survey.

7.5.28 Further detail of the survey methodology is provided in the Aquatic Survey, Appendix 7.6.

Additional walkover surveys

7.5.29 An additional walkover survey to assess aquatic ecology and geomorphology was undertaken in February and May 2019 to identify minor watercourses/ drainage channels within the DCO boundary that could potentially be affected by the Scheme. A number of ephemeral ditches were identified, with approximately 1.9 km of ephemeral ditch identified as being potentially affected by the Scheme. The ditches identified were land drainage ditches that are likely to remain dry throughout much of the year, although when wet, have the potential to provide habitat for aquatic macroinvertebrates and macrophytes.

Arboricultural survey

7.5.30 A tree survey was undertaken in May, July and November 2019 to identify trees within, on and adjacent to the DCO Boundary. This included identifying potential veteran trees. The potential veteran trees were also assessed by an entomologist to determine their value for invertebrates.

7.5.31 Further details regarding the methodology of assessment is provided in the Arboricultural Impact Assessment, Appendix 7.7.

Priority and protected species surveys

Priority plants

7.5.32 A search for priority plant species was undertaken during the extended Phase 1 habitat surveys (2017 and 2019) and NVC survey (2017) described above.

Terrestrial invertebrates

7.5.33 An invertebrate scoping survey was carried out within land northwest of the junction within the DCO boundary, based on a single visit on 27 March 2018. The scoping survey was carried out to assess the potential of the habitats present to support priority species or assemblages of priority species within land affected by the Scheme.

7.5.34 Further detail of the 2018 invertebrate scoping survey methodology is provided in the Invertebrate Scoping, Appendix 7.8.

7.5.35 Additional scoping surveys were undertaken in 2019. In conjunction with arboricultural surveys, a saproxylic invertebrate scoping assessment was undertaken on 1 July 2019 to identify trees of greatest potential value to deadwood-loving species[54] and groups including beetles, flies and stem-nesting nesting bees and wasps. A survey on 21 November 2019 was undertaken to evaluate the likely value of the land in the north west corner of the DCO

[54] Deadwood-loving (saproxylic) invertebrates are dependent on microhabitats associated with the processes of decay and damage in the bark and wood of trees.

boundary (where clay disposal will take place) for invertebrates and how measures could be undertaken to increase its potential to support a rich invertebrate assemblage and provide features into which species could populate.

Great crested newt

7.5.36 OS maps were used to identify all ponds within 250 m of the Scheme. Ponds were scoped out of further survey where no potential impacts on these ponds were identified due to the distance between the pond and Scheme works (see section 7.4). Construction activity associated with the Scheme is focused on land northwest of junction 28, with the exception of temporary works associated with the gas main diversion south of the A12. All other activities are restricted to the existing carriageway or the replacement of signs on existing gantries.

7.5.37 Detailed survey work was carried out in 2017 and 2018 to determine the presence/likely absence of great crested newts in ponds scoped in for survey. These surveys included Habitat Suitability Index (HSI) assessment and presence/likely absence surveys using water sampling (to check for environmental DNA (eDNA)) or conventional survey techniques using bottle-traps, torchlight surveys and egg searches.

7.5.38 Where great crested newt were confirmed as present (confirmed as present in four ponds, reference P2, P3, P4 and P5), six conventional survey visits were carried out to determine the population class-size present in each pond. Six visits were carried out at ponds P2, P4 and P5, between 5 April and 17 May 2018 in appropriate survey conditions following standard guidelines and techniques[55]. Pond P3 was only successfully surveyed on four visits, as it had dried out by visit five.

7.5.39 The surveys were all undertaken by two surveyors and led by a surveyor who held an appropriate great crested newt survey licence.

7.5.40 The maximum adult count per pond survey was used to determine the population size-class to assign to each pond[56] as follows:

- Small – peak count of up to 10 individuals
- Medium – peak count of between 11 and 100 individuals
- Large – peak count of over 100 individuals

7.5.41 Further detail of the survey methodology and location of ponds surveyed is provided in the Great Crested Newt Survey, Appendix 7.9.

Reptiles

7.5.42 Reptile surveys were carried out over seven visits throughout suitable habitat in the field survey study area from 10 August 2017 to the 18 September 2017. The method used for the surveys followed standard survey guidelines[57].

7.5.43 Prior to the survey, on the 7 July 2017, artificial reptile refugia ‘mats’ (1 m x 0.5 m pieces of roofing felt) were placed in areas of suitable reptile habitat within the survey area which included the area within and around the proposed construction footprint, north west of junction 28. Refugia mats were placed within

[55] Guidance provided at: https://www.gov.uk/guidance/great-crested-newts-surveys-and-mitigation-for-development-projects
[56] Guidance provided at: https://www.gov.uk/guidance/great-crested-newts-surveys-and-mitigation-for-development-projects
[57] Gent, T. and Gibson, S., (1998) Herpetofauna Workers’ Manual. JNCC, Peterborough and Froglife (1999) Reptile Survey: an introduction to planning, conducting and interpreting surveys for snake and lizard conservation. Froglife Advice Sheet 10. Froglife, Halesworth.

suitable habitats in the survey area in excess of the minimum guidance which stipulates 'between five to ten refuges per hectare'[58], to maximise the survey effort.

7.5.44 During each survey, the surveyor walked slowly around the survey area and checked the refugia mats and any other natural basking sites and refugia such as rubble and wood for the presence of reptiles. The date, weather, start and finish temperature, reptile species recorded, number of individuals and age (i.e. adult/juvenile) were all recorded on each occasion.

7.5.45 Further detail of the survey methodology and survey locations is provided in the Reptile Survey, Appendix 7.10.

Breeding birds

7.5.46 A breeding bird survey was undertaken on three separate visits between May and July 2017, and an additional two visits were undertaken in March and April 2018 to account for any early breeding activity not captured in 2017. The method used was based on the territory mapping technique, which is similar to that used in the British Trust for Ornithology's Common Bird Census[59,60]. The territory mapping method means that the distribution of bird territories within the survey area, and from this, a count of the number breeding pairs for each species can be derived.

7.5.47 The field survey study area included land within and up to 50 m from the proposed construction footprint. During each visit, the location and species of all birds encountered (including both those seen and those heard) were recorded on a map using standard British Trust for Ornithology (BTO) symbols. Additional information was recorded on bird activity, such as singing or signs of breeding activity, using standard map symbols as stated in Marchant (1983)[61].

7.5.48 Once all visits were complete, the survey data was collated to determine the approximate location and numbers of breeding pairs for territorial and semi-colonial species and to give an indicative total for the survey area as a whole for non-territorial species.

7.5.49 The value of the study area for breeding birds was assessed on a scale from local to national importance, based on a criteria of exceeding 1% of the geographical category, to give the following scale:

- International = SPA qualifying criteria:
  - Site used regularly by 1% of the national population of an Annex 1 species of the EC Birds Directive;
  - Site used regularly by 1% of the biogeographical (international) population of a regularly occurring migratory species (other than those listed in Annex I of the EC Birds Directive) in any season;
  - Site used regularly by over 20,000 waterfowl or 20,000 sea birds in any season
- National:

[58] Froglife (1999) Reptile Survey: an introduction to planning, conducting and interpreting surveys for snake and lizard conservation. Froglife Advice Sheet 10. Froglife, Halesworth.
[59] Marchant, J.H. (1983) Common Birds Census Instructions. BTO
[60] Bibby, C. J., Burgess, N. D. and Hill, D. A. (1992) Bird Census Techniques. Academic Press, London.
[61] Marchant, J.H. (1983) Common Birds Census Instructions. BTO

- Site used regularly by 1% of the national population of a species

- County:
  - Site used regularly by 1% of the county population of a species
  - Site meets County Wildlife Site criteria for birds
- Local:
  - Site supports a population of a species, or a species assemblage of birds, notable for their protected or conservation concern status (Schedule 1 of Wildlife and Countryside Act 1981 (as amended), Annex 2 of EC Birds Directive, Species of Principal Importance, Local BAP, Red List BoCC)

7.5.50 To establish the abundance criteria of the above, each bird species was considered in the context of Essex County. This is taken from The 2018 Essex Bird Report[62].

7.5.51 Further detail of the survey methodology and study area is provided in the Breeding Bird Survey and Barn Owl Survey, Appendix 7.11.

Barn owl

7.5.52 A barn owl survey was undertaken in July and August 2017, which involved an inspection of the properties within the DCO boundary according to best practice guidance[63]. The surveys were undertaken from dusk into the night and also at dawn, which are periods when barn owls are typically active and foraging. In addition, any signs of barn owls were also noted and recorded during bat surveys.

7.5.53 In addition to the surveys, an assessment was also undertaken at a landscape scale including the suitability of the habitats present within the DCO boundary to support barn owl foraging and nesting, and any potential hazard issues associated with potential collision risk.

7.5.54 Further detail of the survey methodology is provided in the Breeding Bird Survey and Barn Owl Survey, Appendix 7.11.

Bats

7.5.55 A summary of the bat survey methodology is provided below. Further detail of the bat survey methodology including the transect routes and locations of locations of trees and building surveyed is provided in the Bat Survey, Appendix 7.12.

Roost surveys

Buildings

7.5.56 A detailed external inspection was undertaken in July 2017 of ten buildings within the DCO boundary to assess their potential to support roosting bats. Binoculars were used where appropriate, but most external inspections were carried out visually.

[62] Essex Birdwatching society (2019). The Essex Bird Report 2018
[63] Barn Owl Trust (2015). Barn Owl Hazards: Major Roads. Devon.

7.5.57 Each building was given a bat roosting potential rating of either high, medium, low or negligible in accordance with Bat Conservation Trust (BCT) guidelines[64]. This initial assessment was used to inform further survey requirements.

7.5.58 Emergence/re-entry surveys were undertaken on buildings identified to be of moderate and low potential to support roosting bats in accordance with good practice guidelines. The emergence/re-entry surveys focussed on the external features identified as having potential for roosting bats, with three experienced surveyors positioned at strategic locations to provide adequate coverage of each of the buildings. In accordance with BCT guidelines, two surveys were carried out at buildings with moderate potential (one dusk and one dawn survey) and one survey at buildings with low potential (dusk survey). Surveys were carried out in appropriate weather conditions and on the following dates: Building 1 and Building 2 (moderate potential) were surveyed in June and August 2017; Building 3 (low potential) was surveyed in August 2019.

7.5.59 Surveyors were equipped with professional bat detectors. During the surveys, two Wildlife Acoustics EM3+ detectors and one Wildlife Acoustics EM Touch detector were utilised.

7.5.60 Bat sightings and behaviour was recorded, along with the time of the record, species, and whether they emerged from or returned to the buildings. The dusk survey began 15 minutes before dusk and ended 1.5 hours after dusk. The dawn survey commenced 1.5 hours before dawn and finished 15 minutes after dawn.

Trees

7.5.61 All trees within the DCO boundary considered likely to be removed, damaged or disturbed by the construction works, were assessed for bat roosting potential as part of the Ground Level Tree Assessment (GLTA).

- Trees northwest of junction 28 were inspected in August 2017, and a further inspection was undertaken in October/November 2019.
- Trees and east of junction 28 were inspected in March 2018, and a further inspection was undertaken in August 2019.
- Trees south of the A12 were inspected in August 2019.

7.5.62 The 2019 update surveys took into account changes in the proposed DCO boundary and construction footprint since the initial survey work for the Scheme. Trees were inspected using binoculars and torches where appropriate, to look for gaps, cracks, splits or woodpecker holes that could potentially be used by roosting bats (referred to as Potential Roost Features - PRF) and for evidence for roosting bats. Such evidence included:

- Droppings
- Urine staining
- Dead bats
- Scratches and oily deposits on feature entrances

7.5.63 All identifiable PRFs on trees were catalogued and photographed and identified for further (climbed) inspection if necessary.

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

7.5.64 Each tree was assigned an initial bat roosting potential category according to the scoring system provided in the BCT guidelines.

7.5.65 The GLTA surveys were used to inform the requirements for an initial aerial tree climbing inspection to confirm bat roosting potential of tree and check PRFs for evidence of bats. Each tree identified for further survey during the GLTA was climbed and inspected using an endoscope and a high-powered torch. Signs of bats were searched for and recorded. Each tree was re-assigned a bat roosting potential category based on the results of the aerial inspection.

7.5.66 An Initial aerial tree climbing inspection was carried out in August 2017 (trees northwest of junction 28, and March 2018 (trees east of junction 28). No trees south of the A12 were identified for further survey.

7.5.67 The GLTAs (2017 to 2019) and initial climbing inspections in 2017 and 2018 were used to inform the further survey requirements in 2019. Due to many of the trees identified being situated in woodland habitats it was concluded that repeated aerial climbing inspections would provide a higher level of confidence in the presence or absence of roosting bats than emergence/ re-entry surveys[65].

7.5.68 A single climbing inspection of moderate and high potential trees was carried out in October and November 2019. Repeat climbing surveys and emergence re-entry surveys proposed for 2019 were constrained by access issues.

Activity transects and static bat detector surveys

7.5.69 Six bat activity transects were conducted monthly within the DCO boundary from May to October 2017. Dusk transects began at sunset and lasted approximately two hours. A dusk to dawn survey was undertaken in June 2017. All transects were carried out using Echo Meter 3+ bat detectors and Echo Meter Touch bat detectors.

7.5.70 The surveyors walked a pre-determined transect route. The route was designed to incorporate and represent all areas and habitat types within the DCO boundary, in land northwest of junction 28 where the main construction works for the Scheme are proposed. The route included 16 static positions (stopping points); 5 minutes was spent at each static position before moving on to the next position.

7.5.71 Two static detectors were also deployed each month in 2017 at different locations along each transect and left to record bat activity for at least five days.

7.5.72 Habitats in the survey area did not change between 2017 and 2019 and repeated transect surveys over the season were not considered necessary to inform the assessment of potential impacts. However, repeated static detector surveys were proposed to in order to verify and update the list of bat species using the survey area. Static detector surveys took place between August and October 2019. Due to land access restrictions static bat detectors could not be deployed earlier in the bat activity season and the deployment locations were restricted to certain locations.

7.5.73 Bat calls were noted in the field and recorded onto a memory card (EM3+ detector). Sonograms of bat calls were subsequently analysed using Analook software. Each call was tagged with the appropriate species for the entire survey data. A five-minute label count of the data was then analysed in Excel. It is

[65] The Bat Conservation Trust survey guidelines (Collins, 2016) recognise that emergence/ re-entry surveys for trees are unlikely to give confidence in a negative result.

recognised that the frequency of calls does not equal the number of bats, as it may indicate the same bat foraging within the same area.

Hazel dormouse

7.5.74 A hazel dormouse survey, using dormouse nest tubes, was undertaken following Natural England guidance[66]. Fifty nest tubes were set out in the woodland and hedgerows within and around the DCO boundary.

7.5.75 The nest tubes were put in place on the 30 May 2017 and following a settling-in period, the tubes were inspected for hazel dormouse or any evidence of hazel dormouse such as nests or feeding remains, on 21 June 2017, 25 July 2017, 31 August 2017, 21 September 2017, 25 October 2017 and 25 November 2017.

7.5.76 No evidence of hazel dormouse was recorded. The length of survey period and survey effort was in accordance with guidance provided by Natural England[67] to determine likely absence if no hazel dormice are recorded.

7.5.77 Further detail of the survey methodology including survey locations is provided in the Hazel Dormouse Survey, Appendix 7.13.

Badger

7.5.78 The study area was surveyed in 2017 and updated 2019 (re-survey of the study area which included new areas of land within the DCO boundary) for the presence of badger which included recording the presence of setts, hairs, footprints, pathways, latrines and feeding signs to plot the patterns of movement of the badgers. Where pathways were confirmed as badger pathways (i.e. there was a clear link to a sett or there was additional evidence of badger activity nearby (such as dung pits, feeding signs or hairs/footprints) these were also noted.

7.5.79 Where setts were found, their status and level of activity was noted. Sett status is broadly categorised as follows:

- Main sett – typically continuously used with numerous signs of activity around. Also have a large number of holes and conspicuous spoil mounds.
- Annexe sett – usually located close to a main sett and connected to it by well used paths. Annexe's may not be continuously occupied.
- Subsidiary sett – lesser used setts comprising a few holes and without associated well used paths. Subsidiary setts are not continuously occupied.
- Outlier sett – one or two holes without obvious paths. These setts are used infrequently.

7.5.80 The level of activity is considered to be:

- Well used – clear of debris, trampled soil mounds and signs of obvious activity.
- Partially used – some associated debris at the entrance and signs of activity within the vicinity, (i.e. badger pathways).

[66] https://www.gov.uk/guidance/hazel-or-common-dormice-surveys-and-mitigation-for-development-projects [accessed May 2017 and January 2020]
[67] https://www.gov.uk/guidance/hazel-or-common-dormice-surveys-and-mitigation-for-development-projects [accessed May 2017] with reference to the following research report: Chanin, P. & Woods, M. (2003). Surveying dormice using nest tubes: results and experiences from the South West Dormouse Project. English Nature Research Report 524. Peterborough: English Nature

- Disused – partially or completely blocked entrances.

7.5.81 Further detail of the survey methodology is provided in the confidential Badger Survey, Appendix 7.14.

Otter and water vole

7.5.82 The watercourses within and up to 1 km upstream and downstream of the DCO boundary (where access was available) were surveyed on 25 May 2017, 27 September 2017 and 9 May 2018 for signs of otter and water vole, and the potential of the watercourses to support these species. The surveys were undertaken at the optimal time for otter and water vole surveys and within periods without rain so any signs of these species such as latrines or spraints would be visible.

7.5.83 The survey included a search for otter footprints, paths, feeding remains, spraints (droppings) and holts (resting places). In addition, camera traps[68] were installed along the Ingrebourne River and Weald Brook from 3 September to 27 October 2017, to identify if otter were moving along the watercourses. The otter survey was undertaken in accordance with standard methodology[69,70].

7.5.84 The survey included a search for signs of water vole, including droppings, burrows, latrines, feeding remains, and footprints. The water vole survey followed standard survey guidance[71].

7.5.85 Further detail of the survey methodology is provided in the Otter and Water Vole, Appendix 7.15.

Invasive species surveys

7.5.86 During the extended Phase 1 habitat survey and NVC survey, a search was made within the DCO boundary for invasive plants subject to legal control, listed in Schedule 9 of the Wildlife and Countryside Act 1981 (as amended). A summary of relevant legislation is provided in the Biodiversity legislation document, Appendix 7.1.

7.5.87 In addition, during the extended Phase 1 habitat survey and other field surveys for priority and protected species, observations from within the DCO boundary of invasive animal species listed in Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) were also recorded.

7.5.88 Species of plants and animals identified as Species of Concern by London Invasive Species Initiative (LISI) were also recorded during field surveys within the DCO boundary. These species are specific to the London area and categorised as a means of prioritisation for land managers[72].

Assessing value of resources and receptors

7.5.89 Nature conservation resources have been valued following the framework provided in Interim Advice Note IAN 130/10 *Ecology and Nature Conservation: Criteria for Impact Assessment*. This is presented in Table 7.4. The evaluation was based on the information available from the desk study and field surveys,

[68] A camera trap is a remotely activated camera equipped with a motion, infrared or light beam sensor as a trigger.
[69] Chanin, P (2003). Ecology of the European Otter. Conserving Natura 2000 Rivers, Ecology Series No. 10. English Nature, Peterborough.
[70] Chanin, P (2003). Monitoring the Otter Lutra. Conserving Natura 2000 Rivers Monitoring Series No 10. English Nature, Peterborough.
[71] Dean, M., Strachan, R., Gow, D., and Andrews, R (2016). The Water Vole Mitigation Handbook
[72] http://www.londonisi.org.uk/ [accessed January 2020]

and used professional judgement, as well as accepted criteria (*e.g.* diversity, rarity and naturalness) (Ratcliffe, 1977) for valuing nature conservation resources in a geographical context.

Table 7.4: Resource valuation[73]

Examples of resource valuation based on geographical context
International or European value
Natura 2000 sites including: Sites of Community Importance (SCIs); SPAs; potential SPAs (pSPAs); SACs; candidate or possible SACs (cSACs or pSACs[74]); and Ramsar sites. Biogenetic Reserves, World Heritage Sites (designated for their nature conservation value), and Biosphere Reserves. Areas which meet the published selection criteria for those sites listed above but are not themselves designated as such[75]. Resident, or regularly occurring, populations of species which may be considered at International or European level[76] where: • The loss of these populations would adversely affect the conservation status or distribution of the species at this geographic scale; or • The population forms a critical part[77] of a wider population at this scale; or • The species is at a critical phase[78] of its life cycle at this scale.
UK or national value
Designated sites including: SSSIs; including Marine Protected Areas (MPAs); Marine Conservation Zones (MCZs); and NNRs. Areas which meet the published selection criteria e.g. JNCC (1998) for those sites listed above but which are not themselves designated as such[79]. Areas of key/priority habitats identified in the UK BAP; including those published in accordance with Section 41 of the Natural Environment and Rural Communities (NERC) Act (2006) and those considered to be of principal importance for the conservation of biodiversity (HPIs)[80]. Areas of Ancient Woodland e.g. woodland listed within the Ancient Woodland Inventory[81]. Resident, or regularly occurring, populations of species which may be considered at International, European, UK or National level[82] where: • The loss of these populations would adversely affect the conservation status or distribution of the species at this scale; or • The population forms a critical part[83] of a wider population at this scale, or

[73] This table and associated footnotes have been copied directly from IAN 130/10 http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs /ian130.pdf
[74] pSACs are sites which have been formally advised to the UK government but have not yet been submitted to the European Commission. These sites should be valued at European level on the basis that they meet the relevant selection criteria for a SAC but are not yet designated as such.
[75] Valuation to be made in consultation with Statutory Environmental Body (SEB, in this Scheme Natural England).
[76] Valuation to be made in consultation with SEB. Such species include those listed within Council Directive 79/409/EEC on the conservation of wild birds or animal/plant species listed within Council Directive 92/43/EEC.
[77] Valuation to be made in consultation with SEB. Such population include sub-populations that are essential to maintenance of metapopulation dynamics e.g. critical emigration/immigration links between otherwise discrete populations.
[78] Seasonal activity or behaviour upon which survival or reproduction depends.
[79] Valuation to be made in consultation with SEB.
[80] Valuation to be made in consultation with SEB as such listings do not in themselves indicate intrinsic value, but instead indicate a conservation priority.
[81] Valuation to be made in consultation with SEB, and with use of professional judgement as listing does not in itself indicate intrinsic nature conservation value.
[82] Valuation to be made in consultation with SEB as such listings do not in themselves indicate intrinsic value. Such species include those listed within Council Directive 79/409/EEC on the conservation of wild birds or animal/plant species listed within Council Directive 92/43/EEC. Species which may be considered at the UK or National level means: birds, other animals and plants which receive legal protection on the basis of their conservation interest (those listed in the Wildlife and Countryside Act 1981 (as amended), SCH 1, 5 and 8); species listed for their principle importance for biodiversity (in accordance with the Natural Environment and Rural Communities Act 2006 Section 41 [England]; and priority species listed within the UKBAP or species listed within Red Data Books.
[83] Valuation to be made in consultation with the SEB. Such populations include sub-populations that are essential to the maintenance of metapopulation dynamics e.g. critical emigration/immigration links between otherwise discrete populations.

Examples of resource valuation based on geographical context

- The species is at a critical phase[84] of its life-cycle at this scale.

Regional value

Areas of key/priority habitats identified in the Regional BAP (where available); areas of key/priority habitat identified as being of Regional vale in the appropriate Natural Area Profile (or equivalent); areas that have been identified by regional plans or strategies as areas for restoration or re-creation of priority habitats (for example South West Nature Map); and areas of key/priority habitat identified within Highways England's Biodiversity Plan.

Resident, or regularly occurring, populations of species which may be considered at an International, European, UK or National level[85][86] and key/priority species listed within the Highway England Biodiversity Plan where:

- The loss of these populations would adversely affect the conservation status or distribution of the species at this scale; or
- The population forms a critical part[87] of a wider population; or
- The species is at a critical phase[88] of its life cycle.

County or Unitary Authority area value

Designated sites including: SINCs; LWSs; and LNRs designated in the county or unitary authority area context[89].

Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such[90].

Areas of key/priority habitats identified in the Local BAP; and areas of habitat identified in the appropriate Natural Area Profile (or equivalent).

Resident, or regularly occurring, populations of species which may be considered at an International, European, UK or National level[91][92] where:

- The loss of these populations would adversely affect the conservation status or distribution of the species across the County or Unitary Authority Area; or
- The population forms a critical part[93] of a wider population; or
- The species is at a critical phase[94] of its life cycle.

Local value

[84] A seasonal activity or behaviour upon which survival or reproduction depends.
[85] Valuation to be made in consultation with the SEB. Such species include those listed within Council Directive 79/409/EEC on the conservation of wild birds or animal/plant species listed within Council Directive 92/43/EEC.
[86] Valuation to be made in consultation with the SEB as such listings do not in themselves indicate intrinsic value. Such species include those listed within Council Directive 79/409/EEC on the conservation of wild birds or animal/plant species listed within Council Directive 92/43/EEC. Species which may be considered at the UK or National level means: birds, other animals and plants which receive legal protection on the basis of their conservation interest (those listed in the Wildlife and Countryside Act 1981 (as amended), SCH 1, 5 and 8); species listed for their principle importance for biodiversity (in accordance with the Natural Environment and Rural Communities Act 2006 Section 41 [England]; and priority species listed within the UKBAP or species listed within Red Data Books.
[87] Valuation to be made in consultation with the SEB. Such populations include sub-populations that are essential to the maintenance of metapopulation dynamics e.g. critical emigration/immigration links between otherwise discrete populations.
[88] A seasonal activity or behaviour upon which survival or reproduction depends.
[89] Valuation to be made in consultation with county ecologist or equivalent, with reference made to the criteria for designation. In terms of Essex, areas which are important for the conservation of wildlife are termed Local Wildlife Sites (LoWSs).
[90] Valuation to be made in consultation with county ecologist or equivalent.
[91] Valuation to be made in consultation with the SEB. Such species include those listed within Council Directive 79/409/EEC on the conservation of wild birds or animal/plant species listed within Council Directive 92/43/EEC.
[92] Valuation to be made in consultation with the SEB as such listings do not in themselves indicate intrinsic value. Such species include those listed within Council Directive 79/409/EEC on the conservation of wild birds or animal/plant species listed within Council Directive 92/43/EEC. Species which may be considered at the UK or National level means: birds, other animals and plants which receive legal protection on the basis of their conservation interest (those listed in the Wildlife and Countryside Act 1981 (as amended), SCH 1, 5 and 8); species listed for their principle importance for biodiversity (in accordance with the Natural Environment and Rural Communities Act 2006 Section 41 [England]; and priority species listed within the UKBAP or species listed within Red Data Books.
[93] Valuation to be made in consultation with the SEB. Such populations include sub-populations that are essential to the maintenance of metapopulation dynamics e.g. critical emigration/immigration links between otherwise discrete populations.
[94] A seasonal activity or behaviour upon which survival or reproduction depends.

Examples of resource valuation based on geographical context
Designated sites including LNRs designated in the local context[95].
Trees that are protected by TPOs.
Areas of habitat; or populations/communities of species considered to appreciably enrich the habitat resource within the local context (such as veteran trees), including features of value for migration, dispersal or genetic exchange.

Table Source: IAN 130/10 http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs /ian130.pdf

Biodiversity impact assessment

7.5.90 A detailed assessment[96] has been undertaken of impacts on biodiversity resources. This assessment incorporates guidance from Design Manual for Roads and Bridges (DMRB) Volume 11: Environmental Assessment, IAN 130/10 and CIEEM Guidelines for Ecological Impact Assessment in the UK and Ireland[97].

7.5.91 The assessment includes an initial characterisation of the potential impacts on biodiversity resources, and takes into account both on-site effects and those that may occur to adjacent and more distant biodiversity resources. Impacts can be permanent or temporary and fall broadly into the following categories:

- Direct loss of habitats (including temporary loss)
- Fragmentation or isolation of habitats
- Changes to the local hydrology, water quality and/or air quality
- Direct mortality or injury to wildlife through construction activities
- Disturbance to species from noise, light or other visual stimuli

7.5.92 Effects resulting from impacts on biodiversity resources have been determined as significant if those impacts change the structure and functions of designated sites, priority habitats, or ecosystems; or the conservation status of habitats and species.

7.5.93 Effects have been identified at the geographic scale at which they become significant, depending on the value of the affected resource and the characteristics of the impact. The residual significance of effects takes into account any mitigation or compensation provided.

7.5.94 Residual effects on nature conservation resources are categorised on the five-point scale in-line with IAN 130/10 shown in Table 7.5. Significance levels other than neutral can be adverse or beneficial. The application of this criteria has been carried out by professional ecologists using their professional judgement.

Table 7.5: Significance of effects[98]

Significance category	Criteria
Very large	An impact on one or more receptor(s) of International, European, UK or National Value.

[95] Valuation to be made in consultation with county ecologist or equivalent, with reference made to the criteria for designation.
[96] According to DMRB Volume 11, Section 2, Part 1 General Principles and Guidance of Environmental Impact Assessment.
[97] CIEEM (September 2018). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester
[98] Table source: IAN 130/10 http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs /ian130.pdf

Significance category	Criteria
	NOTE: only adverse effects are normally assigned this level of significance. They should be considered to represent key factors in the decision-making process.
Large	An impact on one or more receptor (s) of Regional Value. NOTE: these effects are considered to be very important considerations and are likely to be material in the decision-making process.
Moderate	An impact on one or more receptor(s) of County or Unitary Authority Area Value. NOTE: these effects may be important but are not likely to be key decision-making factors.
Slight	An impact on one or more receptor (s) of Local Value. NOTE: these effects are unlikely to be critical in the decision-making process but are important in enhancing the subsequent design of the project.
Neutral	No significant impacts on key nature conservation receptors. NOTE: absence of effects, or those that are beneath levels of perception.

7.6 Assumptions and limitations

General

7.6.1 Ecological surveys are limited by factors which affect the presence of plants and animals such as the time of year, migration patterns and behaviour. Therefore, 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. However, where possible the field surveys have sought to determine the presence or presumed absence of the species involved, based on recognised guidelines for survey effort.

7.6.2 The Phase 1 habitat survey was updated in August and November 2019. Any changes in the habitats within and adjacent to the DCO boundary since the last extended Phase 1 habitat survey in 2017 were recorded. The only change observed was an increase in area of non-native goldenrod species west of Weald Brook. The updated survey provided sufficient information to identify any additional potential impacts relating to biodiversity resources. No additional biodiversity resources or potential impacts were identified.

7.6.3 The detailed (phase 2) survey work for habitats and species has focussed on the potential EZoI, which relates to the anticipated construction and operation impacts of the Scheme. For this reason, survey work was focused on the land northwest of M25 junction 28, where the new loop road will be constructed, and an area of land south of the A12 (west of M25 junction 28) where there are temporary works associated with the gas main diversion. All other works within the DCO boundary are limited to the existing carriageway of the A12 and M25 (e.g. replacement of signs on existing gantries). Where no construction works or very minor construction works (such as sign replacements) are proposed within an area of the DCO boundary, it has not been necessary to carry out detailed phase 2 surveys.

7.6.4 The area proposed for depositing clay excavated during construction (northwest corner of the Scheme) was only identified late in the preliminary design stage, in November 2019. Taking into account the habitats present at this location (field

dominated by non-native goldenrod), the species survey data collected from the southern part of this field is sufficient to inform the assessment of impacts relating to construction at this location and no further surveys were considered necessary.

7.6.5 As described in Section 7.4, guidance from CIEEM[99] indicates that where survey data is 18 months to 3 years old '*A professional ecologist will need to undertake a site visit and may also need to update desk study information'* but also indicates that the potential for mobile species, changes in conditions and local context should be taken into account when determining the requirement for further survey. The updated extended Phase 1 habitat survey undertaken in 2019 confirmed that habitat and conditions within the Scheme remain the same as those found in 2017, with the exception of the presence of non-native goldenrod which has increased in abundance west of Weald Brook. Updates to surveys were proposed in 2019 only where additional information was required (e.g. surveys for roosting bats and invertebrates) or where the DCO boundary was revised. Taking into account the findings of the surveys and current conditions in the survey area, the findings of the 2017 and 2018 surveys for habitats and other species were considered sufficient to inform the impact assessment of the Scheme. Updated surveys for some priority and protected species will be required prior to construction which is standard practice to inform requirements prior to and throughout construction where there is a gap in time between assessment and commencement of construction. Where such surveys would be required, they are listed in the Outline Construction Environmental Management Plan (CEMP) (application document TR010029/APP/7.2).

Species surveys

7.6.6 Species specific limitations are provided in the relevant ES appendices. Key limitations are listed below:

- Reptile surveys:
  - Surveys were undertaken towards the end of the survey season with two visits being undertaken in the August 2019. Guidance suggested August is a sub-optimal months for survey as temperatures can be high. However, temperature and weather conditions were suitable during each survey and, taking into account the low number of reptiles recorded, this is not considered to have affected the overall results of the survey with the majority of visits being undertaken in the optimal month of September.
  - The reptile survey did not extend into the most northwest corner of land within the DCO boundary. Impacts in this area were not included in the design until late 2019, outside of the survey season for reptiles. However, survey work did take place in the southern part of this land, where the habitat is broadly similar (field dominated by non-native goldenrod, with small areas of semi-improved grassland). Taking into account the similar habitats present, the results of the reptile survey carried out are sufficient to support the conclusion of the presence of low numbers of reptiles in this area in line with other suitable habitats within the DCO boundary.
- Bat surveys:

[99] https://cieem.net/wp-content/uploads/2019/04/Advice-Note.pdf

  - Trees within the EZoI were assessed for their suitability for roosting bats in 2017 and 2018 and this was updated in 2019. Tree climbing surveys were undertaken between 2017 and 2019. Suitability categorisations were updated as a result of climbing inspections and as a result of natural changes to the trees during this period. All trees identified as having moderate or high potential for roosting bats have been climbed in 2019 and most at least one further time in 2017/2018. Ideally trees with moderate or high potential for roosting bats would have been climbed or been subject to emergence survey twice or three times (respectively) in 2019. However, such survey was not possible due to access constraints (including safety issues relating to culling of deer). This risks a slight underestimation of the use of trees by roosting bats (in particular; small or transient roosts). This potential underestimation has been considered when assigning the value of the bat assemblage in the study area and the bat assemblage was not undervalued. All trees will be subjected to appropriate pre-construction survey which will inform any site clearance and licence requirements. Although is it possible that an occurrence of a *Myotis* species of bat (in the hand) could have led to species level identification not possible from the sound recordings alone, it is considered unlikely that any additional bat species would have been recorded that were not already recorded in the extensive activity and static detector surveys.

- Breeding bird surveys:
  - The breeding bird survey did not extend into the most northwest corner of land within the DCO boundary. Impacts in this area were not included in the design until late 2019. However, the breeding bird survey transect did extend into this field and record breeding bird activity where noted within the field, but not in the habitat adjacent to the north and west boundary. Whilst the breeding bird surveys did not cover the full site extent of land within the DCO boundary due to these changes, the surveys undertaken have provided a good understanding of the breeding bird species present within the study area and surrounding area. Taking into account the data collected and site conditions, the survey provides sufficient information to determine the valuation of the breeding bird community and subsequent impact assessment.
- Terrestrial invertebrate surveys:
  - The terrestrial invertebrate scoping survey was undertaken in March. Survey in March is sufficient to determine the suitability and initial importance of habitats for terrestrial invertebrates. However, March is a sub optimal time for invertebrate sampling in the field and a full list of invertebrate species can not be determined from a single sampling visit at this time. The scoping survey was also undertaken prior to a changes to the DCO boundary. Therefore, it does not take into account land that has subsequently been included into the study area in the northwest corner of the Scheme. Additional surveys were proposed in 2019. However, access was restricted to very limited parts of the Scheme in 2019 for health and safety reasons, and full survey could not take place. As no full survey has been undertaken, assumptions have been made based upon existing invertebrate data supplied by the various record centres (GiGL, EFC and EWT). This desk study information has been supplemented by the species

sampling data in the 2018 scoping report and also field visits by an experienced terrestrial invertebrate ecologist to assess the habitats and features on two separate occasions, July 2019 (in combination with arboricultural surveys) and November 2019.

- Aquatic surveys:
  - The standard methodology for RCS states each reach should be 500 m. However, only 270 m could be surveyed as this is the length of open watercourse channel present between the current culvert beneath the M25 and the confluence of the Ingrebourne River with the Weald Brook. As only 270 m of open watercourse within the study area is available to survey, the RCS carried out provides sufficient information to inform the valuation and subsequent impact assessment of the Ingrebourne River.
  - One seasons worth of survey was undertaken for macroinvertebrates (autumn 2017). While it is unlikely to provide a full species record, this is considered to provide appropriate characterisation of the aquatic macroinvertebrate community supported by the watercourse and further detailed survey and update survey was scoped out of the assessment taking into account permanence of the watercourses and the low invertebrate diversity recorded in the survey.

7.7 Baseline conditions

7.7.1 The following sections summarise the baseline ecological conditions relevant to the Scheme. Detailed information is provided within the relevant ecological survey reports provided in Appendices 7.2 to 7.15.

Designated sites

7.7.2 The location of the statutory and non-statutory designated sites situated within 2 km of the DCO boundary are shown on Figure 7.3 (Biodiversity Designated Sites) (application document TR010029/APP/6.2).

Statutory designated sites

7.7.3 One LNR (The Manor) is present within 2 km of the DCO boundary. Table 7.6 provides more information on this LNR.

7.7.4 No other statutory designated sites are located within 2 km of the DCO boundary or 200 m of the Affected Road Network. No SACs where bats are one of the qualifying species are present within 30 km of the DCO boundary. The nearest statutory designated site where there is a hydrological connection to the Scheme is Ingrebourne Marshes SSSI, which is 12 km downstream from the DCO boundary on the Ingrebourne River. The nearest European site or Ramsar site hydrologically connected to the Scheme is Thames Marshes and Estuary SPA and Ramsar site, via the Ingrebourne River and River Thames, approximately 35 km downstream. Potential impacts to these sites via hydrological pathways would be negligible taking into account the distance between the Scheme and these sites. Further consideration is provided separately in the HRA (application document TR010029/APP/6.9).

Table 7.6: Summary of statutory designated sites within the study area

Site name	Description	Distance and direction from Scheme	Area	Grid reference
The Manor LNR	A historic landscape made up of acid and neutral grassland, along with ancient and secondary woodland. A wide and diverse range of habitats comprise ponds, hedgerows and lakes which support great crested newt and stag beetle.	0.3 km northwest	60 ha	TQ555923

Non-statutory designated sites

7.7.5 Forty-two non-statutory designated sites (LoWSs in Essex and SINCs in Greater London) were identified within 2 km of the DCO boundary. Information on these sites has been taken from EFC, EWT and GiGL data searches and is provided in the Desk Study, Appendix 7.2.

7.7.6 The majority of the Scheme falls within Ingrebourne Valley Site of Metropolitan Importance (SMI)[100]. In addition, three non-statutory designated sites are directly adjacent to the DCO boundary: Jermains Wood SBI, Folkes Lane (Upminster) SBI and Thee Oaks LoWS. Jermain's Wood SBI and Folkes Lane (Upminster) SBI include sections of the M25 motorway verge.

Ancient Woodland

7.7.7 There are 17 parcels of Ancient Woodland within 2 km of the DCO boundary. A summary of these is provided in the Desk Study, Appendix 7.2, and location of these is shown on Figure 7.1 (Ecological Constraints).

7.7.8 No Ancient Woodland lies within the DCO boundary.

7.7.9 The closest Ancient Woodlands are Lower Vicarage Wood and Vicarage Wood, which lie 40 m from the DCO boundary.

Veteran trees

7.7.10 The desk study found no veteran trees within the Woodland Trust Ancient Tree Inventory[101] within 50 m of the DCO boundary.

7.7.11 The arboricultural survey undertaken in May 2019 identified 15 veteran trees within, on or adjacent to, the DCO boundary. A follow-up survey of these trees in July 2019 was then undertaken with an invertebrate specialist to assess their potential value to saproxylic invertebrates.

7.7.12 The identified veteran trees are shown on the Tree Protection Plan in the Arboricultural Impact Assessment, Appendix 7.7.

Habitats

7.7.13 Habitats present within the DCO boundary are shown on the Phase 1 Habitat Survey (Figure 7.2), priority habitats are shown on the Priority Habitats plan Figure 7.4).

[100] Within Greater London, SINCs are sub-divided into Sites of Metropolitan Importance (SMI); Sites of Borough Importance (SBI) - Grade 1 or Grade 2; and Sites of Local Importance (SLI).
[101] Last accessed January 2020

7.7.14 Detailed information regarding habitats is provided in the Phase 1 Habitat Survey (Appendix 7.3), National Vegetation Classification Survey (Appendix 7.4), River Corridor Survey (Appendix 7.5) and Aquatic Survey (Appendix 7.6) and a summary of the key findings is provided below.

Priority habitats

7.7.15 The desk study, using the MAGIC website, identified potential locations of priority within the study area. These are listed in Appendix 7.2 and shown on Figure 7.4. these include:

- Deciduous woodland – Many parcels of potential priority woodlands are present within the study area. This includes woodland parcels within the DCO boundary. These include Alder Wood and the Grove (described below) and a section of the woodland along the bank of Weald Brook (all of these lie within Ingrebourne Valley SMI). Two other blocks are identified adjacent to the A12. However, site survey confirmed these areas as a linear belt of dense scrub (described below).
- Wood pasture and parkland – the closest area shown lies east of the DCO boundary within The Manor Local Nature Reserve, approximately 280 m of the DCO boundary.
- Lowland meadow - the closest area shown lies east of the DCO boundary within The Manor Local Nature Reserve, approximately 280 m of the DCO boundary.
- Traditional orchard – the closest area shown lies approximately 700 m south of the DCO boundary.

Buildings

7.7.16 Ten building are present within the study area, numbered Buildings 1 to 10.

- Building 1 - Barn type converted residential building with wood cladding and a tiled roof.
- Building 2 - Barn type converted residential building with wood cladding and a tiled roof.
- Building 3 - A residential building of brick with a pitched tiled roof.
- Buildings 4 to 9 - Similar buildings constructed of corrugated material, commercial buildings.
- Building 10 - A breeze block substation with a pitched roof.

7.7.17 Scattered around these buildings were a number of caravans and various types of shipping containers.

Bare ground

7.7.18 Bare ground extended around the commercial buildings (Buildings 4 to 9). The ground is made up of an aggregate and earth type formation compressed to create a hardstanding to allow for the use of vehicles to cross. Another small area of bare ground was noted adjacent to the M25 consisting of a mix of sub and topsoil. In 2019 hardstanding replaced part of a grassland field south of Alder Wood.

Fence

7.7.19 Running almost in parallel to the M25 is a chain-linked fence which is approximately 2.4 m high and assumed to be acting as a deer fence.

Amenity grassland

7.7.20 There are two distinct areas of amenity grassland within the DCO boundary. One area was located around the residential houses (Buildings 1 to 3) and the second made up the fairways on the adjacent golf course (Maylands Golf Club). The species within these areas of amenity grassland are typical of a hard-wearing grassland surface and dominated by perennial rye-grass. Other species that are occasional include: cock's-foot, creeping bent, common cat's-ear, common mouse-ear, daisy, selfheal, vervain, white clover, and yarrow.

Poor semi-improved grassland

7.7.21 The poor semi-improved grassland is located on road verges and agricultural land in the south and east extents of the land northwest of junction 28. This habitat is dominated by tussock forming grasses that include cock's-foot and false oat-grass such as along the edges of the golf course, or by common bent. A range of forbs occurred occasionally within the grassland and include cleavers, common bird's-foot-trefoil, common field-speedwell, common mouse-ear, common ragwort, red clover, smooth tare, spear thistle and yarrow.

Semi-improved neutral grassland

7.7.22 There are extensive areas of semi-improved grassland within the DCO boundary. Some areas are similar in composition with the poor semi-improved grassland (with a dominance of common bent) such as the grassland to the west of Weald Brook, but within the sward is a greater diversity of forb species. In areas where grass species are less dominant there is an acid grassland composition that includes biting stonecrop, lesser stitchwort, parsley piert, sheep's sorrel and tormentil. Sneezewort, was present, growing near the M25 adjacent to tall ruderal vegetation.

7.7.23 In the main, the dominant species are common bent, creeping bent, crested dog's-tail, marsh foxtail, meadow barley, meadow foxtail (*Alopecurus pratensis*), smaller cat's-tail, sweet vernal grass, tall fescue and Yorkshire-fog. The forbs that typically occurred occasionally included: agrimony, common bird's-foot-trefoil, common centaury, common fleabane, common knapweed common mouse-ear, common sorrel, corn mint, lady's bedstraw, meadow buttercup, meadow vetchling and yarrow, with grey sedge and hairy sedge. One area of grassland is different due to the local abundance of common fleabane. This area is located immediately to the north of Grove Farm. In 2019 part of this fleabane area was converted to bare ground.

7.7.24 Early goldenrod is establishing in areas where soils had become exposed, the cover of this species increased between 2017 and 2019.

Tall ruderal

Within the DCO boundary are discrete patches of tall ruderal vegetation typically located close to the M25. These patches include a range of species, including Michaelmas daisy, annual mercury, black horehound, black medick, black nightshade, common poppy, goat's-rue, hedge mustard, hemlock, mugwort,

Oxford ragwort, scarlet pimpernel, swine-cress, upright hedge-parsley, weld, winter-cress and great horsetail.

Tall ruderal (non-native goldenrod)

7.7.25 On the western side of the Weald Brook are extensive areas of non-native early goldenrod. Surveys carried out between 2017 and 2019 have shown that this species has rapidly spread to form dense stands, outcompeting most other grassland species and forming extensive stands of vegetation. This species is also present on the eastern side of the Weald Brook growing in more discrete patches within grassland and woodland habitats. The non-native goldenrod does not appear to be browsed by the local deer population.

Semi-natural broadleaved woodland

7.7.26 Located northwest of junction 28 close to the residential dwellings is a woodland called The Grove. The Grove has a canopy dominated by pedunculate oak with ash, beech, hornbeam, wild cherry and silver birch. The shrub layer is quite sparse with the occasional hazel and patches of bramble. The ground flora contains a number of woodland species that included bluebell, dog's mercury, enchanter's-nightshade, foxglove, garlic mustard, greater stitchwort, wood sage, broad buckler-fern and wood false-brome.

7.7.27 Along the entire length of the Weald Brook is a strip of woodland with a canopy layer made up of alder, ash, blackthorn, dog rose, elder, field maple, hawthorn, hazel, hornbeam, pedunculate oak and white willow (*Salix alba*). The ground flora has patches of common nettle and a scattering of woodland species that included male fern, wood false-brome, dog's mercury, greater stitchwort, moschatel, wood speedwell and remote sedge.

7.7.28 To the east of the M25, immediately north of the A12 is a narrow woodland following the banks of the Ingrebourne River. The dominant tree species is alder, and the ground flora is dominated by grasses including rough meadow grass, Yorkshire fog and creeping bent with occasional wood false-brome.

7.7.29 Further east along the Ingrebourne River (east of junction 28), the woodland widens to broadleaved woodland with a canopy dominated by old coppiced hornbeam with occasional pedunculate oak. The ground flora is very sparse due to deer browsing. This woodland lies adjacent to the DCO boundary and is part of Lower Vicarage Wood LoWS.

7.7.30 In the very northwest of the DCO boundary is a small section of broadleaved woodland which is similar in composition to The Grove.

Broadleaved plantation woodland

7.7.31 North of The Grove is another woodland known as Alder Wood, a broadleaved plantation divided down the centre by a wayleave for an overhead electric line. This plantation is dominated by semi-mature ash, and the main shrub species is hawthorn. There was a very distinctive browse line throughout the plantation due to browsing by deer, mainly fallow deer, and no obvious regeneration of trees. The ground flora has areas of both dog's mercury and wood false brome with occasional wood sedge. Where the canopy has opened up, patches of non-native early goldenrod have established, which seemingly is not browsed by deer. The northern end of the wood is increasingly dominated by hawthorn. To

the southern end of the woodland is a small very shallow wet ditch, which runs into Weald Brook.

7.7.32 To the east of Alder Wood is an embankment of the anticlockwise M25 carriageway planted with broadleaf trees. This plantation is separated from Alder Wood by a chain-link fence. The woodland is younger in age than the ash plantation of Alder Wood, and more diverse in structure due to protection from deer browsing offered by the chain-link fence. Species include: wild cherry, ash, hazel, bramble, hawthorn, hornbeam, wood avens, sycamore, dog's-mercury, herb-robert, ivy, hedge woundwort and wood false-brome. The ground flora was noticeably taller and there was abundant seedling regeneration and no obvious browse lines. Similar plantation is present on the clockwise verge of the M25 northeast of the junction.

7.7.33 At the southern end of Lower Vicarage Wood (adjacent to the DCO boundary) is a small stand of hybrid black-poplar broadleaved planation, located on the north side of a channel that is an old section of the Ingrebourne River.

Mixed plantation woodland

7.7.34 In the southeast corner of The Grove is a stand of mixed woodland dominated by a plantation of Scots pine with occasional pedunculate oak, wild cherry, silver birch, and hornbeam.

Dense scrub

7.7.35 Dense scrub forms a belt of vegetation along the Ingrebourne River south of The Grove. The dominant species recorded is blackthorn, which forms thickets of vegetation. Frequently occurring is hawthorn with occasional pedunculate oak and field maple. The ground flora is typically quite sparse with occasional patches of bramble, and a range of ruderal vegetation, including willowherbs, spear thistle and common nettle.

7.7.36 Dense scrub is also present forming a linear belt immediately north of the A12 to the west of the M25 and is present on the verges of the M25 within junction 28.

Scattered scrub

7.7.37 Scattered scrub (hawthorn) occurs occasionally on the edge of the dense scrub or woodland present within the DCO boundary. Bramble occurs in small patches west of Weald Brook, within the areas of non-native goldenrod.

Scattered broadleaved trees

7.7.38 There are occasional mature/over mature pedunculate oak and other species around the edges of the woodlands within the DCO boundary. A number of these trees are considered veteran trees (see Veteran tree section above).

Species poor intact hedgerow

7.7.39 Parallel with the anticlockwise on-slip from junction 28 to the M25 is a planted hedgerow dominated by hawthorn with occasional ash, field maple, oak and bramble. A mature pedunculate oak is present within the hedgerow.

Standing water

7.7.40 There are two ponds within the DCO boundary:

- Pond P1 is located within The Grove woodland. Pond P1 is heavily shaded by trees, with no marginal vegetation and shallow draw down zones. This pond has been found to dry occasionally.
- Pond P2 adjacent to Maylands Golf Club. Pond P2 is situated in an open field, surrounded by patches of bramble and non-native goldenrod. This pond has been found to dry occasionally.

7.7.41 Ponds outside of the DCO boundary are described in the great crested newt section below.

Watercourses

Weald Brook

7.7.42 The Weald Brook flows from north to south through the DCO boundary. It is heavily shaded through almost the entire reach by mature woodland and scrub lining the banks, limiting marginal and aquatic vegetation to areas where the canopy is open. Woody debris is present within the channel and bankside tree roots create natural planform steps and pool sequences. Bed substrate consist predominantly of silt with notable leaf litter accumulations. Bank width varies between 1 m and 2.5 m through the reach, the water was fairly shallow (average depth of 0.4 m) at the time of surveys (November 2017 and February 2019), with a slow flow visible upstream. Downstream towards the confluence with the Ingrebourne River the watercourse becomes impounded, with the channel wider (2.5 m), deeper (0.5 m) with no flow visible. The banks are approximately 1.5 m high and vary from near vertical to a 45^{o} slope. Further information on the river corridor can be found in the River Corridor Survey Report in Appendix 7.5.

7.7.43 The aquatic macroinvertebrate assemblage is assessed as being of low conservation value (no priority species were recorded, only commonly occurring taxa) and indicates the biological water quality is poor. The species identified also indicate the Weald Brook is predominantly slow flowing and the bed sedimented.

7.7.44 The fish populations are impoverished with only two species recorded in low number. Five bullhead (a Habitats Directive Annex II species, *Cottus gobio*) and one three-spined stickleback (*Gasterosteus aculeatus*) were recorded, both species being typical of the watercourse habitat typology. They are classed as “minor” species by the Environment Agency. Further details on aquatic surveys can be found in the Aquatic Survey Report in Appendix 7.6.

Ingrebourne River

7.7.45 The Ingrebourne River flows from east to west, directly adjacent to the A12 slip road. It has been historically straightened and as a result has a relatively steep gradient creating moderate flow with a mix of gravel and finer grained bed substrate. The channel is shaded from a mix of mature trees and shrubs although marginal vegetation, including fool’s watercress (*Apium nodiflorum*) and brooklime (*Veronica beccabunga*) is present throughout the reach. The bank height is at approximately 0.4 m and channel width approximately 1.5 m. While there is very little sinuosity within the channel, riffles and pools are present throughout with sedimented bars developing. At the downstream end at the confluence with the Weald Brook, the watercourse is slower flowing, sedimented and deeper. Further information on the river corridor can be found in the River Corridor Survey Report in Appendix 7.5.

7.7.46 The aquatic macroinvertebrate assemblage is assessed as being of low conservation value (no priority species were recorded, only commonly occurring taxa) and indicates the biological water quality is moderate. The species identified also indicate the Ingrebourne River is slow flowing and moderately sedimented.

7.7.47 A relatively diverse fish population was recorded, compared to the Weald Brook. A total of 243 individual fishes comprising five different species (bullhead, chub, gudgeon, minnow and stone loach) were recorded during the Ingrebourne River surveys. With the exception of three chub (a species typically associated with gravel bed watercourses) ranging from 66 mm to 135 mm fork length, all other species were “minor” species. Minnow was the most abundant fish species comprising 75% of the total catch and stone loach was the least abundant fish species comprising less than 1% of the total catch. Full details on aquatic surveys can be found in the Aquatic Survey Report, Appendix 7.6.

7.7.48 *Ephemeral ditches*

7.7.49 A number of ephemeral ditches were identified within the DCO boundary that are likely to remain dry throughout much of the year. Two side channels were identified on the Weald Brook, which have the potential to act as backwaters due to the corresponding bed levels. A further three ditches were identified, positioned much higher than the Weald Brook bed level, indicating these would only act as field drainage discharge points during wet periods, rather than backwaters. However, all ephemeral ditches identified have the potential to provide habitat for aquatic macroinvertebrates and macrophytes. No side channels or ditches were identified flowing into the Ingrebourne River. The following ditches were identified on the Weald Brook:

- Small side channel at the most northerly end of the Weald Brook, close to the M25 culvert. The channel contained a large amount of woody debris and aquatic macrophytes, including fool’s watercress. A low flow was perceivable during survey (November 2017 and February 2019) with a mix of sediment and some gravels.
- A side channel approximately 250 m from the northern end of the Weald Brook. No flow was visible at survey, but shading was limited, resulting in aquatic vegetation within the channel.
- A ditch flowing from Maylands Golf Club to the west of Weald Brook, 550 m downstream of the M25 culvert to the north. At the time of survey this ditch was dry and situated high above the Weald Brook channel.
- A ditch flowing east to west along the southern edge of Alder Wood into the Weald Brook in two locations, 800 m and 1 km downstream of the M25 culvert to the north. The ditch was virtually devoid of vegetation except for creeping bent (*Agrostis stolonifera*), except where it reaches the Weald Brook, where there were patches of water mint (*Mentha aquatica*). At the time of survey this ditch was dry and situated high above the Weald Brook channel.

7.7.50 A ditch flowing east to west along the southern edge of The Grove into the Weald Brook approximately 50 m from the downstream confluence with the Ingrebourne River. This ditch was dry at the time of survey and situated high above the Weald Brook channel.

Species-rich defunct hedgerow

7.7.51 Between The Grove and Alder Wood is a defunct hedgerow. Species present within the hedgerow included hawthorn, elder, pedunculate oak, blackthorn, hornbeam and field maple. A large dead pedunculate oak is present at the approximate mid-point of the hedgerow.

Vegetation communities

7.7.52 Full results from the survey including species lists and a figure showing location of the surveys is provided in the National Vegetation Classification Survey, Appendix 7.4

7.7.53 The NVC survey identified three homogeneous areas of semi-improved grassland at the following locations:

- Grassland north of Grove Farm and south of Alder Wood
- Woodland ride east of Weald Brook and west of Alder Wood
- Grassland west of Weald Brook

7.7.54 The woodland ride was well grazed by deer and in many places short, resembling more of a regularly maintained grassland.

7.7.55 All three grassland areas surveyed were classified as MG6b *Lolium perenne-Cynosurus cristatus* grassland, *Anthoxanthum odoratum* sub-community. However, the grassland west of Weald Brook returned a range of NVC community types and the lowest coefficients suggesting the field surveys have not identified a particularly strong fit for any one community.

7.7.56 The total count for species occurring in the semi-improved grassland was 59 species. Of these species, four were considered to be abundant to frequent which included: common bent, crested dog's-tail, Yorkshire fog and common fleabane. All other species were recorded occasionally or rarely.

7.7.57 The total count for species occurring in the woodland across the Scheme was 32 species. Of these, 11 species were identified as Ancient Woodland indicators and included wood meadow-grass, bluebell, moschatel, violet, wood speedwell, pendulous sedge, remote sedge, wood sedge, field maple, hornbeam and wild cherry. The constant species included ash, hawthorn and dog's mercury. All other species were frequent to rare.

7.7.58 The Grove and Alder Wood are very different in terms of their vegetation community types, as The Grove is a native oak woodland, and Alder Wood is an ash plantation.

7.7.59 The total count for species occurring in Alder Wood was 24 species. Of these, two woody species were constant: ash and hawthorn. The only ground flora constant was dog's mercury. The results indicate the community is W8d *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland, *Hedera helix* sub-community, with a looser connection with W12 *Fagus sylvatica-Mercurialis perennis* woodland.

7.7.60 The total count for species occurring in The Grove was 26 species with pedunculate oak as the only constant. The results indicate that this woodland is the community W10 *Quercus robur-Pteridium aquilinum-Rubus fruticosus* woodland.

7.7.61 Table 7.7 provides a summary of the findings from the NVC survey, Appendix 7.4.

Table 7.7: Summary of the NVC survey findings

Section	NVC result (best fit)
Semi-improved grassland (all three sections of grassland)	MG6b Lolium perenne-Cynosurus cristatus grassland, Anthoxanthum odoratum sub-community
Alder Wood	W8d Fraxinus excelsior-Acer campestre-Mercurialis perennis woodland, Hedera helix sub-community
The Grove	W10 Quercus robur-Pteridium aquilinum-Rubus fruticosus woodland

Priority and protected species

Priority plants

7.7.62 To the east of the M25 and to the north of the A12 (outside of the DCO boundary) was a patch of a dozen plants of pennyroyal. Pennyroyal is a species listed under Schedule 8 of the Wildlife and Countryside Act 1981 (as amended). The location of this plant is provided on the Phase 1 Habitat Survey (Figure 7.2).

Terrestrial invertebrates

7.7.63 Table 7.8 identifies records of priority terrestrial invertebrates within 2 km of the DCO boundary, which were obtained during the desk study. Table 7.8 includes all listed species from Essex Field Club but not those with only provisional listing status. However, where provisional listing species have another status, such as Nationally Notable or SPI, they are included.

7.7.64 The list of priority species was analysed using Pantheon[102]. This indicates that most of the priority species noted from within 2 km of the DCO boundary are associated with decaying wood and to a lesser extent tall grass and scrub.

7.7.65 Table 7.9 highlights the main habitats within 2 km of the DCO boundary based on the data search results, and those with the greatest number of associated priority species.

7.7.66 A SAT (Specific Assemblage Types) analysis (Table 7.10) of the same data and search radius highlights the heartwood decay and bark and sapwood decay as the most important SATs within the search radius for scarce species.

7.7.67 The 2018 terrestrial invertebrate scoping survey found suitable habitat exists within the DCO boundary for stag beetle and alder flea-weevil, which are both SPI. There is considered to be high potential for these species to occur within woodland and scrub edge habitats. Elms were not found to be present within the DCO boundary, and therefore based on the absence of suitable habitat for the SPI white-letter hairstreak butterfly, this species is not considered to be present.

7.7.68 The mature trees and shrubs within the DCO boundary (particularly those trees along Weald Brook, hedgerows, fields and on woodland edges) are considered

[102] Webb, J., Heaver, D., Lott, D., Dean, H.J., van Breda, J., Curson, J., Harvey, M.C., Gurney, M., Roy, D.B., van Breda, A., Drake, M., Alexander, K.N.A. and Foster, G. (2017). Pantheon - database version 3.7.6. [online] Available at: http://www.brc.ac.uk/pantheon/ [Accessed 25 November 2019]
Pantheon is an analytical tool developed by Natural England and the Centre for Ecology & Hydrology to assist invertebrate nature conservation in England. Users import lists of invertebrates into Pantheon, which then analyses the species, attaching associated habitats and resources, conservation status and other codings against them. This information can then be used to assign quality to sites, assist in management decisions and augment other ecological study.

to have high potential for priority invertebrates, particularly deadwood invertebrates (saproxylics) and to a lesser extent, arboreal canopy invertebrates such as moths.

7.7.69 The Grove and Alder Wood are considered to have at least moderate potential for priority invertebrates.

7.7.70 Non-native goldenrod dominated fields west of Weald Brook., Although not a native species, is included in this valuation given its probable importance to pollinators. The sward is also complimented by other flowering plants including dog rose, brambles and other common grassland and scrub edge flowering plants.

7.7.71 Some of the grassland and scrub fringed pasture habitat is considered to have moderate potential for priority invertebrates as noted in Table 7.10.

7.7.72 Further information is provided in the Invertebrate Scoping Survey, Appendix 7.8.

Table 7.8: Terrestrial invertebrate records

Common name	Scientific name	Frequency	Approximate distance and direction of closest records from DCO boundary[103]	Date of most recent record	WCA Schedule 5	SPI [104]	London BAP	Other designation (Red Data Book, IUCN)	EFC / EWT
A beetle	Abraeus granulum	1	Within 2 km of the DCO boundary	2010				●	
Magpie moth	Abraxas grossulariata	5	1.5 km	2016					●
A fly	Acartophthalmus bicolor	1	1.9 km	1980				●	
Knot grass moth	Acronicta rumicis	3	c. 1.64 km east	2013		●	●		
A beetle	Aderus populneus	1	Within 2 km of the DCO boundary	2010				●	
A fly	Agathomyia falleni	1	2 km	1996				●	
Mouse moth	Amphipyra tragopoginis	2	c. 1.64 km east	2013		●	●		
A longhorn beetle	Anaglyptus mysticus	1	1.6 km	2019				●	
A mining bee	Andrena fucata	1	1.1 km	1998					●
A mining bee	Andrena varians	1	1.2 km	1985					●
Large nutmeg moth	Apamea anceps	1	2.6 km	1985		●			
Garden tiger moth	Arctia caja	1	2.9 km (10 km accuracy)	1972	●	●	●		
Large black slug	Arion ater	1	1.1 km	1998				●	
Centre-barred sallow moth	Atethmia centrago	1	1.4 km	2016		●			

[103] Where the exact location is not provided with desk study records, this is noted as 'within 2 km of the Scheme'. Where only distance from DCO boundary is provided with desk study records (and not exact location), it is not possible to add the direction from the DCO boundary.
[104] Species of Principal Importance (SPI), listed under Section 41 of the NERC Act (2006)

Common name	Scientific name	Frequency	Approximate distance and direction of closest records from DCO boundary[103]	Date of most recent record	WCA Schedule 5	SPI [104]	London BAP	Other designation (Red Data Book, IUCN)	EFC / EWT
A fly	Atypophthalmus inustus	1	2 km	1982				•	
A fly	Aulacigaster leucopeza	1	1.1 km	1989				•	
A fly	Aulogastromyia anisodactyla	1	1.9 km	1981				•	
A beetle	Axinotarsus ruficollis	2	1.8 km	1985				•	
A fly	Brachyopa insensilis	1	2 km	1989					•
Green hairstreak butterfly	Callophrus rubi	1	1.3 km	2017					•
Mottled rustic moth	Caradrina morpheus	1	2.6 km	1985		•			
A moth	Catoptria falsella	1	1.5 km	2016					•
A fly	Cephalops carinatus	1	1.8 km	1981				•	•
Latticed heath	Chiasmia clathrata	17	1 record within the DCO boundary	2014		•	•		
A spider	Cicurina cicur	1	1.4 km	1990				•	
Small heath	Coenonympha pamphilus	307	4 records within the DCO boundary	2016		•	•		
A fly	Colobaea punctata	1	1.8 km	1977				•	•
A moth	Commophila aeneana	1	1.4 km	2017					•
A beetle	Cryptarcha strigata	1	1.8 km	1982				•	•
A beetle	Cryptophagus micaceus	3	Within 2 km of the DCO boundary	2010				•	

Common name	Scientific name	Frequency	Approximate distance and direction of closest records from DCO boundary[103]	Date of most recent record	WCA Schedule 5	SPI [104]	London BAP	Other designation (Red Data Book, IUCN)	EFC / EWT
A beetle	Ctesias serra	1	Within 2 km of the DCO boundary	2010				•	
A beetle	Curculio villosus		1.8 km	1979				•	•
A fly	Dioxyna bidentis	1	1.8 km	1976				•	•
A beetle	Donacia obscura	1	1.8 km	1977				•	
A beetle	Dorcatoma flavicornis	1	Within 2 km of the DCO boundary	2010				•	
Small phoenix moth	Ecliptopera silaceata	1	2.6 km	1985		•			
A beetle	Eledona agricola	1	Within 2 km of the DCO boundary	2010				•	
A beetle	Enicmus brevicornis	1	Within 2 km of the DCO boundary	2010				•	
Small red-eyed damselfly	Erythromma viridulum	6	1.8 km	2012					•
A moth	Eudonia pallida	1	1.5 km	2016					•
A beetle	Euglenes oculatus	1	Within 2 km of the DCO boundary	2010				•	
Jersey tiger moth	Euplagia quadripunctaria	6	1.7 km	2014			•		
A beetle	Euplectus mutator	1	Within 2 km of the DCO boundary	2010				•	
A fly	Fannia gotlandica	1	1.9 km	1980				•	
A fly	Fannia speciosa	1	1.6 km	1980				•	

Common name	Scientific name	Frequency	Approximate distance and direction of closest records from DCO boundary[103]	Date of most recent record	WCA Schedule 5	SPI [104]	London BAP	Other designation (Red Data Book, IUCN)	EFC / EWT
Ghost moth	Hepialus humuli	2	2.6 km (10 km accuracy)	1985		●			
A fly	Heringia vitripennis	1	1.9 km	1976					●
A fly	Hilara pseudochorica	1	2 km	1978				●	
A fly	Hybomitra bimaculata	1	1.4 km	1974				●	●
A beetle	Hylis olexai	1	Within 2 km of the DCO boundary	2010				●	
A beetle	Ischnomera sanguinicollis	2	1.8 km	1977				●	
A beetle	Kalcapion semivittatum	1	1.8 km	1977				●	●
A fly	Lasiambia baliola	3	2 km	1981				●	
A fly	Lasiambia brevibucca	1	1.8 km	1980				●	
Wall	Lasiommata megera	18	Within the DCO boundary	2001		●	●		
Beautiful hook-tip moth	Laspeyria flexula	1	1.4 km	2016					●
A fly	Leia piffardi	1	1.6 km	1980				●	
A fly	Lejogaster tarsata	2	1.5 km	1981					●
Scarce emerald damselfly	Lestes dryas	2	c. 715 m northwest	2012			●		
A fly	Limonia nigropunctata	1	1.1 km	1998				●	
A fly	Lispocephala falculata	1	1.6 km	1982				●	

Common name	Scientific name	Frequency	Approximate distance and direction of closest records from DCO boundary[103]	Date of most recent record	WCA Schedule 5	SPI [104]	London BAP	Other designation (Red Data Book, IUCN)	EFC / EWT
A beetle	Lissodema denticolle	1	Within 2 km of the DCO boundary	2010				•	
Stag beetle	Lucanus cervus	4	c. 0.8 km	2004		•	•	•	•
A fly	Madiza britannica	1	2 km	1982				•	
A beetle	Megatoma undata	1	Within 2 km of the DCO boundary	2010				•	
A fly	Melanogaster aerosa	1	1.8 km	1985					•
A fly	Meligramma euchromum	1	1.8 km	1979				•	•
A fly	Meligramma trianguliferum	1	1.8 km	1981					•
A fly	Merzomyia westermanni	1	1.1 km	1977				•	•
A beetle	Mycetophagus piceus	1	Within 2 km of the DCO boundary	2010				•	
A fly	Myolepta dubia	1	2 km	1979				•	•
A fly	Neoascia interrupta	1	1.5 km	1981				•	•
A fly	Neophyllomyza acyglossa	1	2 km	1980				•	
A fly	Odinia hendeli	1	1.1 km	1989				•	
A fly	Oliarus panzeri	1	1.8 km	1984					•
Alder flea weevil	Orchestes testaceus	1	Within 1 km	1987		•			
A fly	Orthonevra brevicornis	1	1.5 km	1982					•

Common name	Scientific name	Frequency	Approximate distance and direction of closest records from DCO boundary[103]	Date of most recent record	WCA Schedule 5	SPI [104]	London BAP	Other designation (Red Data Book, IUCN)	EFC / EWT
A beetle	Orthoperus nigrescens	1	Within 2 km of the DCO boundary	2010				•	
A fly	Palliduphantes insignis	2	1.4 km	1991				•	
A fly	Peribaea setinervis	1	1.9 km	1980				•	
A fly	Phaonia atriceps	1	1.7 km	1976				•	
A fly	Pherbellia brunnipes	1	1.9 km	1978				•	•
A fly	Pherbellia dorsata	1	1.5 km	1979				•	•
A spider	Philodromus albidus	1	1.1 km	1998				•	
A beetle	Phloiotrya vaudoueri	1	Within 2 km of the DCO boundary	2010				•	
A beetle	Phyllotreta striolata	1	1.8 km	1977				•	
A beetle	Phyllotreta vittula	1	1.8 km	1977				•	
A beetle	Phytoecia cylindrica	1	1.8 km	1979				•	
A fly	Pilaria scutellata	1	1.8 km	1980				•	
A fly	Pipunculus zugmayeriae	1	1.8 km	1979				•	
A spider	Pirata uliginosus	2	1.4 km	1990					•
Jenkins' spire snail	Potamopyrgus antipodarum	1	1.5 km	1985				•	
A beetle	Prionocyphon serricornis	1	1.8 km	1982					•

Common name	Scientific name	Frequency	Approximate distance and direction of closest records from DCO boundary[103]	Date of most recent record	WCA Schedule 5	SPI [104]	London BAP	Other designation (Red Data Book, IUCN)	EFC / EWT
A beetle	Procraerus tibialis	1	Within 2 km of the DCO boundary	2010				•	
A fly	Psacadina verbekei	2	1.7 km	1978				•	•
A fly	Pseudolyciella pallidiventris	1	2 km	1980				•	
A beetle	Pseudotriphyllus suturalis	1	Within 2 km of the DCO boundary	2010				•	
A fly	Psilota anthracina	1	1.7 km	1981				•	
A beetle	Quedius (Microsaurus) aetolicus	1	Within 2 km of the DCO boundary	2010				•	
A beetle	Quedius (Microsaurus) scitus	1	Within 2 km of the DCO boundary	2010				•	
A fly	Rhamphomyia albitarsis	1	1.8 km	1980				•	
A fly	Rhipidia uniseriata	2	2 km	1982				•	
A fly	Sapromyza obsoleta	1	1.6 km	1976				•	
White-letter hairstreak butterfly	Satyrium w-album	128	4 records within the DCO boundary	2016	•	•	•		
A fly	Scaeva selenitica	1	1.5 km	1977					•
Shaded broad-bar	Scotopteryx chenopodiata	49	1 record within the DCO boundary	2016		•	•		
Buff ermine moth	Spilomena lutea	1	Within 2 km of the DCO boundary	2017					

Common name	Scientific name	Frequency	Approximate distance and direction of closest records from DCO boundary[103]	Date of most recent record	WCA Schedule 5	SPI [104]	London BAP	Other designation (Red Data Book, IUCN)	EFC / EWT
White ermine moth	Spilosoma lubricipeda	2	c. 350 m north	2011		●	●		
A beetle	Stictoleptura scutellata	1	1.8 km	1980				●	
Ruddy darter dragonfly	Sympetrum sanguineum	1	0.7 km	2000					●
A fly	Symphoromyia immaculata	1	1.8 km	2978				●	●
A fly	Systenus bipartitus	1	2 km	1980				●	
A fly	Tachypeza fuscipennis	7	2 km	1982				●	
A spider	Thanatus striatus	7	1.4 km	1990				●	
Blood-vein moth	Timandra comae	5	c. 150 m southwest	2014		●	●		
A bug	Tingis reticulata	1	1.8 km	1976					●
A fly	Typhamyza bifasciata	1	1.5 km	1980				●	
Cinnabar moth	Tyria jacobaeae	47	2 records within the DCO boundary	2016		●	●		
A fly	Volucella zonaria	1	1.5 km	2015					●
Oak hook-tip moth	Watsonalla binaria	1	1.5 km	2016		●			
A fly	Woodiphora retroversa	1	1.8 km	1980				●	

Table 7.9: Pantheon habitats output table

Broad biotope	Habitat	No. of species	Species with conservation status
Tree-associated	Decaying wood	40	34
Open habitats	Tall sward & scrub	23	19
Tree-associated	Arboreal	15	9
Wetland	Peatland	15	10
Tree-associated	Shaded woodland floor	10	6
Open habitats	Short sward & bare ground	8	7
Wetland	Marshland	4	2
Wetland	Running water	3	1
Wetland	Lake	1	1
Wetland	Wet woodland	1	-
Tree-associated	Wet woodland	1	-
Coastal	Brackish pools & ditches	1	-

Table 7.10: Pantheon SAT output table

Broad biotope	Habitat	SAT	SAT Code	No. of species	Species with conservation status
Tree-associated	Decaying wood	Heartwood decay	A211	17	14
Tree-associated	Decaying wood	Bark & sapwood decay	A212	9	8
Wetland	Peatland	Reed-fen & pools	W314	4	4
Open habitats	Short sward & bare ground	Open short sward	F112	3	3
Open habitats	Scrub edge	F001	3	2	-
Tree-associated	Decaying wood	Fungal fruiting bodies	A213	3	2
Open habitats	Rich flower resource	F002	2	1	-
-	-	Epiphyte fauna	A215	1	-
Wetland	Running water	Stream & river margin	W114	1	1
Wetland	Peatland	Open water in acid mire	W311	1	1

Great crested newt

7.7.73 Full details of the great crested newt survey methodology and results are provided in the Great Crested Newt Survey, Appendix 7.9. Pond numbers referred to in the paragraphs below are referred to in Appendix 7.9 and associated figures included in Appendix 7.9.

7.7.74 Data provided by EWT indicates that a meta-population of great crested newts is present west and northwest of the DCO boundary, in ponds around Dagnam Park, The Manor LNR and Maylands Golf Club. The EWT data included peak counts per pond which ranged from 1 to 10. The nearest record for great crested newts identified during the desk study is from c.180 m to the west of the Scheme from 2009. However, biological records provided by GiGL did not provide a precise location or map for this record. The meta-population of great crested newts present northwest of the Scheme is described as the largest known population of great crested newt in London Borough of Havering, and largest in Greater London[105].

7.7.75 A search of MAGIC found records of two European Protected Species Mitigation (EPSM) licences for great crested newts were identified 1 km to the west of the Scheme. These licences ran from 2012 to 2013 (EPSM2011-2843) and 2012 to 2015 (EPSM2012-4454).

7.7.76 Eight ponds were scoped in for further survey, including two within the DCO boundary, and six within 250 m of the DCO boundary. A summary of the survey results is provided in Table 7.11. Great crested newts are confirmed as present in one pond within the DCO boundary (P2) and three ponds within 250 m of the DCO boundary (P3, P4 and P5).

7.7.77 Due to the proximity of ponds P2, P4 and P5, it is assumed these ponds form a metapopulation of great crested newt. Taking into account the results of the surveys and peak counts, it is assumed that the size of the metapopulation is medium. The peak count for the metapopulation (data from the three ponds combined) for any one survey visit was 46 individuals. The great crested newts utilising pond P2, P4 and P5 are assumed to be part of the wider population present west and northwest of the Scheme around Dagnam Park and The Manor LNR.

7.7.78 A small population of great crested newt is present to the south of the A12, in pond P3. This pond is south of the A12, 20 m from the DCO boundary.

7.7.79 Terrestrial habitat suitable for great crested newts, including woodland, scrub and grassland habitats, is present within the DCO boundary and construction footprint. The presence of the M25 and A12 corridors forms a barrier to the movement of great crested newts. Although dispersal across these features may be possible via culverts along Weald Brook and Ingrebourne River when conditions are suitable, it is considered likely that there is limited regular dispersal between ponds separated by these roads. Therefore, P2, P4 and P5 likely forms the most south and east extent of aquatic habitat utilised by the wider metapopulation present in this area, with populations which may be present east or south of the M25/A12 forming separate populations.

7.7.80 Terrestrial habitat within the DCO boundary that lies within 250 m of pond P2, P4 and P5 includes areas of woodland, scrub and rough semi-improved grassland. The field surrounding P2 is largely dominated by non-native goldenrod. This vegetation may provide some sheltering and foraging opportunities for great crested newt. However, the non-native goldenrod outcompetes the native grassland forming tall, dense stands shading other plant species reducing diversity of vegetation which may in turn reduce potential diversity of foraging opportunities. Pond P2, P4 and P5 are present west of Weald Brook. There is

[105] London Borough of Havering Biodiversity Supplementary Planning Document: https://www3.havering.gov.uk/Documents/Planning/LDF/Protecting-Enhancing-Boroughs-Biodiversity-SPD.pdf [accessed November 2019]

potential for great crested newts to cross this watercourse in suitable conditions. However, as dispersal across the watercourse is likely to be restricted, it is assumed that habitat east of Weald Brook (on the opposite side to the ponds) does not form part of the core terrestrial habitat for this metapopulation.

Table 7.11: Great crested newts survey results

Pond ref.	Description	Distance and direction from DCO boundary	Pond suitability (HIS score category)	Great crested newt presence and population size
P1	Within The Grove woodland, heavily shaded by trees leaving the pond with no marginal vegetation, with shallow draw down zones	Within the DCO boundary	Below average	Assumed absent (negative eDNA)
P2	Situated within an open field adjacent to the golf course, surrounded by non-native goldenrod with patches of coarse, tussocky grassland.	Within the DCO boundary	Average	Medium population (peak count 22)
P3	Situated to the south of the A12 surrounded by scrub, within an agricultural field.	20 m south	Average	Small population (peak count 2)
P4	Partially shaded by trees on the edge of a golf fairway.	120 m northwest	Good	Small population (peak count 6)
P5	Within a small woodland surrounded by golf course.	190 m west	Excellent	Medium population (peak count 21)
P6	Formal duck pond, heavily used by wildfowl including geese.	185 m west	No further survey, unsuitable for great crested newt.	
P38	Pond shown on OS map. Pond no longer exists.	Within DCO boundary	No further survey, pond no longer present.	
P39	Pond shown on OS map. Pond no longer exists.	10 m	No further survey, pond no longer present.	

Reptiles

7.7.81 The desk study data provided records for a single grass snake sighting described as near Weald Brook. The exact location is not provided, but it is possible this sighting was within the DCO boundary. Data also included records slow worm within 1.4 km and records of adder were at Tylers Common, 1 km to the south of the DCO boundary.

7.7.82 Two common lizards were recorded during reptile surveys within the survey area, and evidence of breeding was found by the presence of a juvenile lizard. No other reptile species were recorded. The common lizards were recorded in the northern section of the DCO boundary, one west of Weald Brook and the other within grassland east of Weald Brook.

7.7.83 Whilst not recorded during surveys, it is expected that low numbers of grass snake may use habitats present within the DCO boundary.

7.7.84 Further information regarding the survey results, and a map of the survey location is provided in the Reptile Survey, Appendix 7.10.

Birds

Breeding birds

7.7.85 The desk study identified records of priority bird species kingfisher and little egret, both from the Weald Brook within the Scheme. Records of tree pipit, lesser spotted woodpecker and black redstart, which are priority species, were provided from within 2 km of the DCO boundary. Habitats present within the DCO boundary are not considered to be suitable for these species.

7.7.86 During breeding bird surveys, the greatest number of breeding birds were located within the woodland running either side of Weald Brook. The wooded habitats to the north and south of the study area, and the pockets of scrub interspersed within the grassland habitat to the west of Weald Brook supported relatively moderate numbers of breeding birds. The areas of open grassland were the least favoured habitat with predominantly foraging and commuting behaviour observed only.

7.7.87 The locality of breeding bird territories reflects the distribution of suitable habitats within the survey area. Weald Brook supported a greater diversity of habitats than the rest of the survey area which was heavily grazed by deer and generally lacked nesting opportunities. The habitats surrounding the Weald Brook comprised scrub, woodland and tall ruderal habitat.

7.7.88 The woodlands were also heavily affected by deer grazing, which significantly reduced the amount of nesting habitat available, reducing the distribution of common and widespread scrub nesting birds, such as blackcap, dunnock, chiffchaff and blackbird.

7.7.89 A total of 31 species were considered to be breeding within the survey area during the bird surveys.

7.7.90 Six priority species, or those with a higher level of legal protection under Schedule 1 of the Wildlife and Countryside Act 1981 (as amended), were recorded (see Table 7.12).

Table 7.12: Protected / priority bird species within the survey area

Common name	Scientific name	Number of territories present within the DCO boundary	Sch1	SPI	LBAP [106]	Red List[107]	Amber List[107]
Dunnock	*Prunella modularis*	6		•			•
Kingfisher	*Alcedo atthis*	1	•				•
Reed bunting	*Emberiza schoeniclus*	2			•		•
Song thrush	*Turdus philomelos*	3		•	•	•	

[106] Priority species listed in the previous Greater London, Essex or London Borough of Havering BAPs
[107] Birds of Conservation Concern, based on the UK Red List for Birds, publish in The full details of this assessment can be found in Eaton et al. (2015).

Common name	Scientific name	Number of territories present within the DCO boundary	Sch1	SPI	LBAP [106]	Red List[107]	Amber List[107]
Starling	*Sturnus vulgaris*	1		•	•	•	
Willow warbler	*Phylloscopus trochilus*	1					•

7.7.91 Kingfisher was the only Schedule 1 species recorded, foraging along Weald Brook. Although no breeding activity was noted, kingfisher was considered likely to be breeding along Weald Brook. The banks of Weald Brook are steep and earthy, with the potential to support nesting kingfisher.

7.7.92 Further details of the breeding bird survey results including territory maps are provided in the Breeding Bird Survey and Barn Owl Survey, Appendix 7.11.

Barn owl

7.7.93 No records for barn owl were identified during the desk study from within the DCO boundary, the nearest being 1.6 km to the east.

7.7.94 No evidence of barn owl was recorded within any of the buildings within the DCO boundary. No trees within the study area provided suitable nesting opportunities. The buildings within the industrial yard were steel framed structures which were heavily disturbed by human activity. The residential buildings within the south-eastern corner of Grove Farm were also similarly disturbed and no access points suitable for barn owl were recorded.

7.7.95 The study area is located within the proximity of two major roads (A12 and M25). Although main roads account for the majority of barn owl casualties, several habitats with the potential to support hunting barn owl were located within the study area. Habitats comprised woodland, grassland, and a brook, which are likely to support a good number of rodent species. No evidence of foraging barn owl was recorded during the seven bat activity surveys, which were undertaken for two hours after sunset (when barn owls are typically active), between May and October (inclusive). Barn owl is assumed to be absent from the study area.

7.7.96 Further information regarding the barn owl survey is provided in the Breeding Bird Survey and Barn Owl Survey, Appendix 7.11.

Bats

7.7.97 Further details of the bat survey results are provided in the Bat Survey, Appendix 7.12 which includes a plan showing the location of trees and buildings surveyed.

7.7.98 EFC, GiGL, EWT and EBG data included records of 10 bat species recorded within 5 km of the DCO boundary: noctule, soprano pipistrelle, common pipistrelle, Leisler's bat, Natterer's bat, brown long-eared, serotine, Daubenton's bat, Nathusius' pipistrelle and barbastelle. The information from the Essex Bat Group received in 2019 indicated that the barbastelle had been recorded within Weald Country Park on at least six occasions. The closest record being approximately 1.5 km to the northeast of the DCO boundary.

7.7.99 MAGIC (2019) returned three records of EPSM licences for bats within 2 km of the DCO boundary:

- 2017-29257-EPS-MIT (Natterer's and soprano pipistrelle) - July 2017 to June 2027. Destruction of a resting place – c.1 km to the east of the Scheme.
- EPSM2012-4100 (Common pipistrelle) – February 2012 to March 2014. Destruction of a resting place – c.1 km west of the Scheme.
- 2015-9990-EPS-MIT (Common pipistrelle and brown long-eared bat) – May 2015 to July 2017. Destruction of a breeding site – c.1.5 km southeast of the Scheme.

7.7.100 No SACs listing bats as a qualifying species are located within 30 km of the DCO boundary.

Bat roosts

7.7.101 No evidence of roosting bats was recorded in any buildings. Descriptions of the buildings and their bat roosting potential is summarised in Table 7.13.

Table 7.13: Summary of buildings surveyed with bat roosting potential

Building	Description	Potential to support roosting bats
1 & 2	Adjoining timber barns with shiplap walls and a clay tiled roof. The interior appeared to be used for storage purposes although disturbance was considered to be minimal due to the absence of vehicles and machinery within the buildings. Although the roof exterior was in good condition, several holes within the shiplap boarding were identified on the northern side.	Moderate
3	A detached, two-storey property with a shiplap timber exterior and tiled roof. The building was not of modern construction and therefore wear to the exterior was present. As with Building 1, holes were present within the exterior timber which may offer potential access for bats and it appeared that a loft void was present. The building was within proximity to junction 28, which likely has a significant impact on foraging and commuting bats around the building due to noise. Security lighting is present on and around the building throughout the light, lighting potential roosting features, reducing the potential for bats to roost.	Low
4 to 9	Large steel framed constructions with large open fronted entrances. The interior lacked a wooden framed structure, typically needed to support roosting bats. All buildings were heavily disturbed due to the working nature of the site and all buildings had high powered external lighting. No features with the potential to support roosting bats were identified.	Negligible
10	Electrical substation. No features of note were identified externally.	Negligible

7.7.102 Following GLTA and climbing inspections, a total of 69 trees within the survey area were categorised as follows[108]:

- Confirmed roost – 1 tree: single common pipistrelle recorded in tree 36 in November 2019
- High potential – 6 trees
- Moderate potential – 21 trees
- Low potential – 41 trees

7.7.103 All other trees were considered to have negligible potential for bats to roost.

7.7.104 A single common pipistrelle was recorded in a large tree fissure (tree 36) in November 2019. In 2017, a grey squirrel dray was present in this fissure. It is possible that this is a transient roost for one or small numbers of pipistrelle or other bat species. However, in the absence of additional survey data, for the purposes of the assessment it is assumed that as a reasonable worst case, this feature could be used as a summer maternity roost.

Commuting and foraging habitat – bat activity surveys

7.7.105 Woodland, grassland, hedgerows, scrub and watercourses through the survey area provide suitable foraging habitat for bats. The study area forms the south east corner of an area of relatively open landscape bound by the M25 corridor to the east and A12 corridor to the south. Lighting is present around junction 28, slip roads and along the M25 and A12 adjacent to the survey area. Security lighting is also present around buildings and yards at Grove Farm, east of Weald Brook.

7.7.106 The static detector and bat transect surveys identified seven species of bats using habitats within the survey area to commute or forage common pipistrelle, soprano pipistrelle, brown long-eared, Myotis sp., Leisler's bats, Nathusius' pipistrelle). Bat activity was primarily focused on the woodland and scrub edge habitat with linear features. The Weald Brook and the western edge and glade of Alder Wood supported the main commuting activity through the study area. Common pipistrelle was the species most frequently recorded during survey work. Although soprano pipistrelle activity was slightly less frequent, the habitat utilisation was similar, primarily using the woodland and scrub edges for foraging and commuting.

7.7.107 Leisler's bat activity was predominantly focused around Alder Wood, particularly along the glade. Most of this data was returned from the static detectors, including 114 calls in June. This activity was likely down to foraging activity of individual Leisler's bats utilising the woodland edge.

7.7.108 Noctule were not recorded using the habitats within the DCO boundary and were only seen commuting high above the Scheme across the landscape. This commuting behaviour is typical of noctule.

7.7.109 Low numbers of *Myotis* species, brown long-eared bat and Nathusius' pipistrelle were also recorded along the western edge of Alder Wood and Weald Brook. These species were picked up infrequently and are considered to be using the linear features for occasional commuting through the study area.

[108] Due to the large number of trees within the survey area the Bat Survey Report, Appendix 7.12, only lists negligible trees where they were initially categorised as having low, moderate or high potential during GLTA but were assigned as negligible following detailed climbing inspection.

7.7.110 The 2019 static surveys provided limited data but identified six species of bats utilising the study area, none of which were additional to those species identified in 2017. These species were common pipistrelle, soprano pipistrelle, Myotis sp., Leisler's bat, noctule and brown long-eared bat. Nathusius' pipistrelle was not recorded in 2019. The habitats and conditions within the survey area have not changed since the 2017 surveys. Whilst the data collected is limited, the mix of species recorded has not changed and it is expected that bats are using the same habitats and features within the study area as was observed in 2017.

7.7.111 Barbastelle was not recorded during survey work. A population of barbastelle is known to be present at Weald Country Park, northwest of the Scheme (closest record 1.5 km from the DCO boundary). Daubenton's bat have also been recorded at Weald Country Park. Weald Country Park is separated from the study area by the M25 corridor. Both barbastelle and Daubenton's are light-adverse species[109] and individuals of these species roosting at Weald Country Park may be deterred from foraging within the study area by the presence of lighting along the section of the M25 which separates the study area from Weald Country Park. Weald Brook passes beneath the M25, but the bridge/culvert is low and unlikely to be used by these species as a commuting route. Taking into account the lack of records during survey work, barbastelle are assumed absent from the study area.

7.7.112 Further detail of the results of the bat survey, including maps showing survey results is provided in the Bat Survey, Appendix 7.12.

Hazel dormouse

7.7.113 The desk study returned no records for hazel dormouse within 2 km of the Scheme.

7.7.114 No evidence of hazel dormouse was recorded during the surveys undertaken during 2017. Due to heavy grazing primarily by fallow deer and the lack of defined shrub layer, the woodland within the DCO boundary is considered generally unsuitable to support hazel dormice. There is no understorey, scrub or bramble habitat that would provide a means for dormice to move around the habitat, as well as a food source. The habitat along Weald Brook is more suitable due to the presence of scrub and hazel (a primary food source of hazel dormice), but no signs were recorded in this section of the Scheme. Hazel dormouse are considered absent from the Scheme and are not included further in this impact assessment.

7.7.115 Further detail of the hazel dormouse survey and results is provided in the Hazel Dormouse Survey, Appendix 7.13.

Water vole

7.7.116 The desk study identified records of water vole sightings 1.2 km northwest of the DCO boundary from 2007.

7.7.117 No signs of water vole were recorded during the surveys undertaken in 2017. A burrow of a suitable size for water vole was recorded on Weald Brook near its confluence with the Ingrebourne River. However, as no other evidence of water vole was recorded elsewhere, it is considered likely that the burrow was excavated by either rat or signal crayfish which have also been recorded in the

[109] Institute of Lighting Professionals and Bat Conservation Trust (2018). Guidance Note 08/18. Bats and artificial lighting in the UK. Bats and the Built Environment Series.

watercourses. Additional signal crayfish burrows were identified on the Ingrebourne River south of the A12 (outside of the DCO boundary).

7.7.118 The section of Ingrebourne River within the DCO boundary was considered to be more suitable than the Weald Brook for water vole, with bank vegetation suitable for providing a foraging source. However, bank profiles were typically shallow which is less suitable for the creation of burrows. In addition, an extensive box culvert (over 100 m in length) was present at the eastern extent of the Scheme. This is likely to restrict movement of water voles.

7.7.119 As no evidence of water vole has been recorded, water vole are considered likely absent from within the study area and are not included in the impact assessment for the Scheme. However, as set out in section 7.10 below, pre-construction check for this species will be included as a precaution.

7.7.120 Further information regarding the water vole survey, including survey location and results is provided in the Otter and Water Vole Survey, Appendix 7.15.

Otter

7.7.121 The desk study data identified two records of otter sightings on the Ingrebourne River south of the DCO boundary, both sightings in 2014.

7.7.122 No evidence of otter holts was recorded within the study area during the surveys. However, a single old otter spraint was recorded on the Ingrebourne River), under the bridge of the access from Grove Farm to the A12 off-slip to junction 28. This was recorded during the aquatic invertebrate surveys in August 2017. The subsequent deployment of camera traps did not identify any sightings of otters using the watercourses at that time.

7.7.123 The Weald Brook is predominantly devoid of vegetation due to shading from trees. However, areas of scrub were present along the Weald Brook which could provide suitable shelter for otters. The Weald Brook and Ingrebourne River provides suitable commuting habitat for otter due to their connectivity to other watercourses in the wider landscape.

7.7.124 Considering the geographical the typical territory sizes[110] of otter, it is assumed that the watercourses in the study area represent a small part of the home range of individual otter.

7.7.125 Further information regarding the otter survey, including survey location and field survey and desk study results is provided in the Otter and Water Vole Survey, Appendix 7.15.

Badger

7.7.126 Badgers were recorded within the study area.

7.7.127 Details of the badger survey results can be found in the confidential Badger Survey, Appendix 7.14. Due to the vulnerability of badgers to persecution, Appendix 7.14 is confidential, but is available on request where required.

Other mammals

7.7.128 The desk study identified records of the following priority mammal species from within 2 km of the DCO boundary: harvest mouse and hedgehog. Three records

[110] Chanin P (2003). Ecology of the European Otter. *Conserving Natura 2000 Rivers Ecology Series* **No. 10**. English Nature, Peterborough. Otter density as ranging from 2–50 ha of water per otter, which was equivalent to one individual every 3–50 km of stream (median value of one otter per 15 km of stream).

of harvest mouse were returned, with the nearest approximately 1.5 km to the north and the most recent from 1999. Three records of hedgehog were returned, with the nearest approximately 0.5 km to the southwest and the most recent from 2013.

7.7.129 Habitat within the survey area provides opportunities for harvest mouse and hedgehog.

7.7.130 A large population of fallow deer identified during the desk study include sightings of up to 120 individuals. Fallow deer were regularly recorded during survey work in large numbers, and muntjac were recorded on camera traps. Fallow and muntjac deer are not a protected or priority species.

Non-native invasive species

Flora

7.7.131 The desk study identified records of 9 invasive species listed in Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) from within 2 km of the DCO boundary. These include: water fern, cotoneaster, curly waterweed, giant hogweed, giant knotweed, Indian (Himalayan) balsam, Japanese knotweed, parrot's-feather, rhododendron and three-cornered garlic.

7.7.132 Records of 16 species listed as species of concern by LISI were also identified from within 2 km of the Scheme. These species and Schedule 9 species identified are listed in the Desk Study, Appendix 7.2.

7.7.133 Only one non-native invasive species as listed under Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) was recorded during field surveys between 2017 and 2019 which was Himalayan balsam. This species was recorded on the Ingrebourne River either side of the box culvert going under the M25. The location of this plant is shown on Figure 7.1 (Ecological Constraints).

7.7.134 In addition, two LISI Species of Concern, goat's-rue and Himalayan balsam, were recorded. Goat's rue is present within tall ruderal habitat adjacent to the M25.

7.7.135 Another non-native species that was recorded within the DCO boundary is early goldenrod. This species is identified as invasive under the Non-Native Species Secretariat[111], and it has formed extensive stands in particular down the western side of the Weald Brook and is likely to be spreading, impacting mainly on the grassland flora. The density and cover of this species changed between the initial extended Phase 1 Habitat Survey in 2017 and the updated survey in 2019, resulting in further reduction of grassland habitat. Occasional patches of early goldenrod is occasionally found east of Weald Brook, within grassland and within Alder Wood and The Grove.

7.7.136 Further information about the location of this species is provided in the Phase 1 Habitat Survey, Appendix 7.3 and is shown on the Phase 1 Habitat Survey Plan, Figure 7.2.

Invasive fauna

7.7.137 The following species listed in Schedule 9 of the Wildlife and Countryside Act 1981 (as amended), were recorded during surveys undertaken within the DCO boundary:

[111] http://www.nonnativespecies.org/gallery/index.cfm?query=Early%20Goldenrod&start=1&searchtype=s [accessed November 2019]

- A ring-necked parakeet territory was recorded along Weald Brook.
- Chinese muntjac were recorded several times on a camera trap along the Ingrebourne River. In addition, 20 records of Chinese muntjac were identified during the desk study. The nearest record was approximately 0.7 km to the west of the DCO boundary.
- Grey squirrel was recorded within the DCO boundary.
- Signal crayfish was recorded in the Weald Brook during surveys of the Scheme. Burrows for this species was also observed on this watercourse, and on the Ingrebourne River south of the A12. Remains of a signal crayfish were also observed in a pedunculate oak during climbing inspections for bat roosts.

Evaluation of biodiversity resources

7.7.138 The nature conservation value of the biodiversity resources within the EZoI is described in Table 7.14.

Table 7.14: Nature conservation value of resources

Resource	Value[112]	Justification
Ancient Woodland	National	Ancient Woodland is an irreplaceable resource.
Veteran trees	County or Unitary Authority	The NPPF (2019) considers veteran trees to be 'irreplaceable habitat.' However, the ecological value of these habitats in the context of the wider countryside needs to be considered. The veteran trees identified within, on or adjacent to the DCO boundary have features suitable for specialised invertebrates of decaying wood including the stag beetle (SPI) and other beetles such as *Hylis olexai* (Red Data Book 3) and *Procraenus tibialis* (Red Data Book 3). The specific value of the veteran trees to saproxylic invertebrates is the presence of both sapwood and heartwood decay and also water-filled rot holes.
The Manor LNR	County or Unitary Authority Area	This site of also part of Dagnam Park and Hatter's Wood SMI, designated for its value in the context of the Greater London Metropolitan area.
Ingrebourne Valley SMI	County or Unitary Authority Area	This site is designated for its value in the context of the Greater London Metropolitan area.
Other non-statutory sites (Local Wildlife Sites / Sites of Nature Conservation Importance)	County or Unitary Authority Area	LoWS and SBI designated for their value in the context of the county of Essex, London Borough of Havering and London Borough of Upminster. Includes areas of designated sites outside of Ancient Woodland.
Broadleaved woodland (including plantation) – outside of designated sites	Local	This habitat within the EZoI outside of Ancient Woodland and designated sites includes potential priority habitats, but is generally composed of small stands and plantation on the adjacent golf course and highway verges.

[112] Valuations follows guidance in IAN 130/10, see Section 7.4, with justification provided where otherwise.

Resource	Value[112]	Justification
Semi-improved grassland – outside of designated sites	Local	This habitat outside of designated sites is generally species-poor, and includes highway verges, pasture and disturbed areas. These are not considered priority habitats.
Species-poor hedgerow – outside of designated sites	Local	This habitat outside of designated sites is species-poor.
Weald Brook	County or Unitary Authority Area	The Weald Brook is a tributary of the Ingrebourne River, and forms part of the wider Ingrebourne Valley SMI. Within the DCO boundary the watercourse is sinuous and supports a range of in-channel habitats including exposed tree roots and woody debris accumulations that enrich habitat complexity. The watercourse is heavily shaded by riparian trees which acts to limit the range and distribution of aquatic macrophytes. It supports an impoverished fishery with only two 'minor' fish species record at low density. The aquatic macroinvertebrate assemblage is also species poor and contains no priority taxa. Biological metrics are indicative of a community constrained by water quality and potentially periods of low flow, and the effects of fine sediment accumulation. As a component of the wider Ingrebourne valley SMI, this HPI, is considered to be of County or Unitary Authority Area value on account of the range of habitats (in-channel and riparian) it supports and its value as a wildlife corridor.
Ingrebourne River	County or Unitary Authority Area	The Ingrebourne River forms part of the wider Ingrebourne Valley SMI. Within the DCO boundary the watercourse has been historically straightened. Despite this modification it still supports a good range of habitat (pools, riffles and bars) and flow conditions. Marginal macrophytes are present throughout where absence of shading facilitates their establishment. The range of habitat conditions provided are in part reflected by the fish populations recorded which included high densities of some "minor" species and notably low numbers of chub, a species predominantly associated with gravel bed systems. No priority aquatic macroinvertebrates were recorded at survey and biological metrics are indicative of a community constrained by water quality and potentially periods of low flow, and the effects of fine sediment accumulation. As a component of the wider Ingrebourne valley SMI, this HPI, is considered to be of County or Unitary Authority Area value on account of the range of habitats (in-channel and riparian) and fish species it supports.
Ephemeral ditches	Local	A number of heavily modified/managed ephemeral ditches with limited habitat or ecological complexity are present within the DCO boundary. They are however noted for their potential to provide some value as aquatic resources for part of the year (when

Resource	Value[112]	Justification
		wet) and form a series of wildlife corridors linked to the Weald Brook and surrounding habitats.
Ponds	Local	Ponds outside of designated sites are generally small and shaded by trees and not considered to be HPI.
Pennyroyal	County or Unitary Authority Area Value	Any loss of this population would adversely affect the conservation status or distribution of this species within the County or Unitary Authority Area.
Terrestrial invertebrates	County or Unitary Authority Area	Loss of this assemblage of species would adversely affect the conservation status of the constituent species within the County or Unitary Authority Area.
Stag beetle	County or Unitary Authority Area	Stag beetle is a Species of Principal Importance and any loss of this species population would adversely affect the conservation status within the County or Unitary Authority Area.
Alder flea-weevil	County or Unitary Authority Area	A Species of Principal Importance, and any loss of this species population would adversely affect the conservation status within the County or Unitary Authority Area.
Great crested newt	County or Unitary Authority Area	Great crested newt is a Species of Principal Importance and any loss of this species population would adversely affect the conservation status within the County or Unitary Authority Area. The meta-population of great crested newts present northwest of the Scheme (in an around Dagnam Park) is the largest known population of great crested newt in London Borough of Havering, and largest in Greater London[113].
Reptiles	Local	This assemblage of species is considered to appreciably enrich the habitat resource within the local context. However, loss of this assemblage is not expected to adversely affect the conservation status of the reptile species within a wider area.
Birds	Local	Loss of this assemblage of species would adversely affect the conservation status of the constituent species within the County or Unitary Authority Area.
Kingfishers	Local	Loss of this species population would adversely affect the conservation status within the County or Unitary Authority Area.
Bats	Local	This assemblage of species is considered to appreciably enrich the habitat resource within the local context. Common pipistrelle, soprano pipistrelle, brown long-eared are described by Essex Bat Group and London Bat Groups as common and widespread[114],

[113] London Borough of Havering Biodiversity Supplementary Planning Document: https://www3.havering.gov.uk/Documents/Planning/LDF/Protecting-Enhancing-Boroughs-Biodiversity-SPD.pdf [accessed November 2019]
[114] Information taken from London Bat Group website: https://londonbats.org.uk/bat-cave/bats-of-london/

Resource	Value[112]	Justification
		Nathusius' pipistrelle is described as widespread, but scarce in Essex and Greater London but may be under-recorded.[115] Leisler's bat is described by Essex Bat Group as widespread but scarce. Leisler's is not regularly recorded in Greater London.
Otter	County or Unitary Authority Area	Loss of this population would adversely affect the conservation status of otters within the County or Unitary Authority Area.
Badger	Local	Badger are widespread and are not listed as an SPI in the UK or locally. However, they are afforded legal protection through the Protection of Badgers Act 1992 which protects them from persecution. Therefore, in the context of the Scheme, badger are of local value.
Hedgehog and harvest mouse	Local	There is potential for hedgehog and harvest mouse to be present within the DCO boundary.

7.7.139 Fallow deer are not considered an important biodiversity receptor in the context of this impact assessment. Whilst a large population of fallow deer is present using habitat within the DCO boundary, fallow deer are not rare in a local or national context and are not a nature conservation priority. In addition, this species is not protected by legislation relating to nature conservation. Therefore, fallow deer are not included in the assessment of impacts. The presence of deer has been taken into account within the biodiversity assessment where measures may be necessary to ensure appropriate establishment of planting designs, or where measures required for road safety may affect other priority species.

7.8 Potential impacts

Ecological Zone of Influence

7.8.1 The final EZoI within which all potential impacts on biodiversity resources could occur was determined following the desk study and all field surveys, and a review of the preliminary design (Design Fix 3). The final EZoI has been used to define the biodiversity resources included in the assessment.

Designated sites, Ancient Woodland and veteran trees

7.8.2 In setting the final EZoI for designated sites, it has been taken into account that the PPGs/GPPs and CIRIA guidance on the control of water pollution from construction sites will be implemented to present any impacts on water courses or priority aquatic habitats. With suitable pollution measures in place, direct impact will only result where any in-channel works are required. Any in-channel works will be contained within the DCO boundary.

7.8.3 With the exception of air quality it is expected that the EZoI will include designated sites, Ancient Woodland and veteran trees within or adjacent to the DCO boundary. Potential impacts related to changes in air quality may extend up to 200 m from the Affected Road Network (ARN).

[115] Information taken from Essex Bat Group website: http://essexbatgroup.org/about/bats-of-essex/ [accessed January 2020]

Habitats (outside of designated sites and Ancient Woodland)

7.8.4 Due to the generally localised nature and level of impact of the construction and operation works, it is considered that potential impacts from the Scheme on habitats outside of designated sites will be restricted to within or directly adjacent to the DCO boundary. Priority habitats within or directly adjacent to the DCO boundary are located within designated sites or areas listed as Ancient Woodland, and are therefore considered as part of the designated site or Ancient Woodland within the assessment.

Priority and protected species

7.8.5 The EZoI for protected and priority species has been defined on a species-specific bases based on the likely effects of the Scheme as detailed in Table 7.15 below.

Table 7.15: Final EZoI for priority and protected species

Species	Distance from the DCO boundary		Justification
	Construction	Operation	
Priority plants	Within construction footprint	Within operational footprint	Due to the generally localised nature and level of the impact of the construction and operational works, it is considered appropriate to only assess impacts on priority plants within or directly adjacent to the DCO boundary. Pennyroyal, the only priority plant recorded to date, lies outside of the DCO boundary and is therefore scoped out of the assessment.
Bats	100 m	Within operational footprint and ARN	Although bats are known to commute large distance between roosts and foraging habitats, direct construction and operations impacts are likely to be restricted to commuting, foraging and roosting habitat within 30 m of the construction and permanent footprint. However, due to the creation of new features through existing foraging routes and potential for indirect impacts such as noise and lighting during construction on roosts, the EZoI is extended to 100 m.
Great crested newt	250 m	Within operational footprint	Impacts on great crested newt could occur through habitat damage and loss, with potential for killing and injury during construction. Although great crested newts can use suitable terrestrial habitat within 500 m of a breeding pond, there is usually a decrease in newt abundance beyond 250 m from a breeding pond[116]. It is therefore considered that the Scheme

[116] English Nature (2004). An assessment of the efficiency of capture techniques and the value of different habitats for the great crested newt (ENRR576) http://publications.naturalengland.org.uk/publication/134002

Species	Distance from the DCO boundary		Justification
	Construction	Operation	
			has the potential to affect populations or metapopulations of great crested newts using ponds located within 250 m of the Scheme construction and permanent footprint only. During operation, impacts will be limited to small scale maintenance works affecting habitat and individual great crested newts within the Scheme.
Reptiles	Within and immediately adjacent to the construction footprint	No impacts identified	Impacts on reptiles will occur through habitat loss and potential for killing and injury during construction.
Breeding birds	50 m	Within/adjacent to the permanent footprint	Construction works could potentially disturb breeding birds within and adjacent to the construction footprint. Once operational, disturbance will be limited to the immediate vicinity of the permanent footprint.
Otter	100 m	Within/adjacent to the permanent footprint	Construction works may disturb breeding holts if present within 100 m of the works. During operation, aquatic habitat severance could force otters to cross the carriageway where they will be susceptible to collisions.
Terrestrial invertebrates	Within and immediately adjacent to the construction footprint	Within newly created/reinstated habitat within DCO boundary	Terrestrial invertebrates could be affected by habitat loss within the construction footprint. There is the potential for encroachment into adjacent habitats.
Hedgehog and harvest mouse	Within and immediately adjacent to the construction footprint	Within/adjacent to the permanent footprint	These species may be directly affected by habitat loss during construction. During operation, potential impacts are limited to the operational footprint.

Designated sites

Statutory sites

Construction

7.8.6 The Manor LNR is located approximately 150 m[117] from the DCO boundary. The closest proposed works to the LNR relate to the golf course mitigation, and includes the use of an area of existing hardstanding as a compound, and remodelling of the layout of the course. These works are small scale and localised, making use of existing golf course fairways and features. Due to the

[117] Distance amended as result of change in DCO boundary associated with Change 7.

distance between these works and LNR, and lack of obvious hydrological links, no direct impacts caused by pollution during construction are anticipated.

7.8.7 The construction impacts on the LNR relating to noise, lighting or visual disturbance is likely to be negligible, given the distance of the LNR from the DCO boundary, and the current levels of disturbance.

7.8.8 There would be no construction impacts on other statutory designated sites.

Operation

7.8.9 Due to the distance between The Manor LNR and the Scheme, no direct impacts from operation of the Scheme are likely.

7.8.10 Given the distance of the LNR from the Scheme, the noise, lighting or visual impacts on species within the designated site generated by the operation of the Scheme are likely to be negligible.

7.8.11 Impacts on designated sites due to changes in air quality are unlikely to extend more than 200 m from the ARN, and therefore will not affect this LNR (the LNR lies approximately 400 m from the ARN). No other statutory designated sites are present within 200 m of the Affected Road Network.

Non-statutory sites

Ingrebourne Valley SMI

Construction

7.8.12 The northern section of the Ingrebourne Valley SMI lies within the DCO boundary. The location of designated sites is provided in Figure 7.2 (Biodiversity Designated Sites). There would be a permanent and direct impact on this designated site through a loss of habitat, changes to habitats and potential changes to local hydrology and water quality as a result of the A12 off slip construction works and the need to realign sections of Ingrebourne River.

7.8.13 During construction, a total of 24.8 ha of terrestrial habitat (which equates to approximately 9.4% of the total SMI area (which is 262.56 ha)) will be damaged or disturbed as a result of construction of the loop road, earthworks and structures, site compound and haul routes and the associated gas main diversion. Approximately 5.2 ha of this terrestrial habitat loss during construction will be permanent (which equates to approximately 2 %[118] of the total area of the SMI) due to the construction of the loop road and provision for mitigation relating to Maylands Golf Club. Loss of terrestrial habitat within Ingrebourne Valley SMI is summarised in Table 7.16. Further details of the balance of permanently lost and reinstated habitats is given in section 7.9.

7.8.14 Construction would result in the direct loss of broadleaved semi-natural woodland at The Grove and along Weald Brook, broadleaved plantation woodland at Alder Wood, dense scrub and semi-improved neutral grassland. Construction would also result in the loss of areas dominated by non-native early goldenrod.

[118] Permanent loss is taken to include: new road and road infrastructure including balancing ponds and verge (taken to be areas designed with 'highways amenity seed mix' (see section 7.9). The figure for permanent loss is also includes small area of land which will be incorporated into Maylands Golf Club operational land

7.8.15 Construction could cause the fragmentation of semi-improved neutral grassland and broadleaved woodland along the Weald Brook, which could cause a reduction in habitat connectivity.

Table 7.16: Approximate total terrestrial habitat loss within Ingrebourne Valley SMI due to the construction of the Scheme (including permanent and temporary working areas)

Habitat[119]	Area of impact (ha) during construction
Semi-natural broadleaved woodland	1
Broadleaved plantation	2.2
Mixed plantation woodland	0.1
Dense scrub	3.4
Semi-improved neutral grassland	12.0
Poor semi-improved grassland	0.1
Species-rich defunct hedgerow	20 linear metres
Tall ruderal vegetation	0.3
Tall ruderal (non-native goldenrod)	5.7
Amenity grassland	<0.01
Bare ground	<0.01
Total loss	24.8 ha (9.4%[120] of land within the SMI)

7.8.16 The construction of the Scheme would result in temporary and permanent impacts on the sections of Ingrebourne River and Weald Brook which run through the DCO boundary, including the loss of open channel along Ingrebourne River due to the unavoidable extension of a river culvert. Weald Brook and Ingrebourne River form part of Ingrebourne Valley SMI. Detailed potential impacts on these aquatic habitats are set out in the 'watercourse' section below.

Operation

7.8.17 As indicated above, 5.2 ha of habitat within Ingrebourne Valley SMI will be permanently lost to the scheme (this equates to approximately 2%[121] of the total area of the SMI).

7.8.18 There could also be a direct impact on species and habitats within the section of Ingrebourne Valley SMI within the immediate vicinity of the new loop road due to operational noise levels, lighting and visual stimuli and potential changes in air quality. Any beneficial or adverse effects in air quality due to changes in traffic will not extend further than 200 m from the ARN, and will affect only a relatively small proportion of the SMI. The SMI extends several kilometres south from the DCO boundary. Air quality immediately adjacent to the new loop road or realigned slip roads may decrease. However, taking into account the proximity of these habitats to the existing carriageway of the M25, A12 and junction 28,

[119] This list does not include small areas of hardstanding. Scattered scrub is excluded as this is present over grassland habitat.
[120] Ingrebourne Valley SMI is 262.56 ha. Loss during construction is 24.8 ha.
[121] Permanent loss is taken to include: new road and road infrastructure including balancing ponds and verge (taken to be areas designed with 'highways amenity seed mix' (see section 7.9). The figure for permanent loss is also includes small area of land which will be incorporated into Maylands Golf Club. However, this area will contain grassland and scrub habitats.

decrease in air quality adjacent to the new loop road is unlikely to result in adverse effects on habitats present substantially above those currently experienced within this northern section of the SMI.

7.8.19 Construction of the Scheme would involve the creation of new structures across the Weald Brook and Ingrebourne River, which may affect the movement of species through this section of the SMI.

7.8.20 Potential impacts on species are set out in relevant sections below.

Other non-statutory sites

Construction

7.8.21 Jermains Wood SBI and Folkes Lane (Upminster) SBI lie adjacent to DCO boundary in the southwest of the Scheme. These designated sites include a section of the M25 motorway verge. The construction works proposed along this section of the M25 include replacement of signs on existing gantries. No habitat loss or other works within the boundary of these SBI are anticipated.

7.8.22 The Oaks LoWS lies directly adjacent to the DCO boundary, and Lower Vicarage Wood LoWS lies 40 m from the DCO boundary.

7.8.23 It is possible that temporary indirect impacts on these four non-statutory designated sites may arise during construction due to the proximity of the working area to the sites. These impacts could include ground and surface water pollution, noise and visual disturbance as a result of the construction works. However, only minor works are required to the existing carriageway and signs within the vicinity of these non-statutory designated sites, and these potential impacts are considered unlikely.

Operation

7.8.24 The Scheme will introduce a new loop road through Ingrebourne Valley SMI. There may be impacts on existing and replacement habitats within close proximity to the new road due to changes in air quality.

7.8.25 The Oaks LoWS and Lower Vicarage Wood LoWS are currently situated close to the existing carriageway of the M25 and A12. These two LoWS lie within 200 m of the ARN. Due to the proximity of these LoWS to the existing road infrastructure, any decrease in air quality is unlikely to result in adverse effects on LoWS habitats substantially above those currently experienced by these habitats. Any beneficial effect in air quality due to changes in traffic within the ARN are likely to be minor.

Ancient Woodland

Construction

7.8.26 No direct impacts are anticipated on Ancient Woodlands due to construction of the Scheme. However, Lower Vicarage Wood lies 40 m from the DCO boundary. Temporary indirect impacts in relation to dust, noise, visual disturbance may occur as a result of construction. All works are retained within the existing carriageway. No changes to hydrology or buffer habitats between the woodland and the carriageway will take place.

7.8.27 Jackson's Wood, Folkes Lane Woodland, and Foxburrow Wood/Coombegreen Wood are Ancient Woodlands that lie between 10 m and 30 m of the DCO

boundary which runs along the M25 south of junction 28. Along this section of the Scheme, the proposed works include replacement of signage on existing gantries. No impacts on these woodlands are expected as a result of these works.

Operation impacts

7.8.28 Lower Vicarage Wood lies within 200 m of the ARN. Due to the proximity of this ancient woodland to the existing road infrastructure, any decrease in air quality is unlikely to result in adverse effects on ancient woodland habitat substantially above those currently experienced by this ancient woodland. Any beneficial effect in air quality due to changes in traffic within the ARN are likely to be minor.

Veteran trees

Construction

7.8.29 Two veteran trees (T021A and T074) have been identified that would be permanently lost as a result of the Scheme. The layout and design of the Scheme has a number of constraints, including highways safety and clearance from floodplain. Efforts have been made within the design to avoid veteran trees including proposed departures from Highways Standards where necessary. However, there are no feasible design options available to retain these two trees. A departure from Highways Standards has been proposed by to allow the retention of Tree T059, but a workable re-design to avoid the removal of trees T021A and T074 has not been possible. A further eight veteran trees lie within temporary construction working areas and all would be retained during construction. Without mitigation, there is a risk of damage to these eight trees during construction.

Operation

7.8.30 Veteran trees within 200 m of the ARN and the new loop road may be affected by changes in air quality. Due to the proximity of these trees to the existing road infrastructure, any decrease in air quality is unlikely to result in adverse effects on veteran trees substantially above those currently experienced by these trees. Any beneficial effect in air quality due to changes in traffic within the ARN close to individual trees is likely to be minor.

Habitats (outside of Ingrebourne Valley SMI)

Construction

7.8.31 The construction of the Scheme would result in the direct loss of broadleaved plantation woodland, scrub, tall ruderal, semi-improved grassland and amenity grassland on existing highway verges and the golf course.

7.8.32 Terrestrial habitat loss (outside of Ingrebourne Valley SMI) is summarised in Table 7.17. Further details of the balance of permanently lost and reinstated habitats is given in section 7.9.

Table 7.17: Approximate total terrestrial habitat loss (outside of Ingrebourne Valley SMI) due to the construction of the Scheme (including permanent and temporary working areas)

Habitat[122]	Area of impact (ha) outside of Ingrebourne Valley SMI
Broadleaved plantation	0.6
Dense scrub	1.4
Semi-improved neutral grassland	5.2
Species-poor hedgerow	160 linear metres
Tall ruderal vegetation	0.2
Tall ruderal (non-native goldenrod)	0.1
Amenity grassland	2.2
Total	9.7 ha

Operation

7.8.33 Additional negative impacts resulting from traffic or disturbance in operation of the Scheme over and above those currently experienced by existing or replanted habitats which lie adjacent to existing road infrastructure is.

Watercourses

Weald Brook

Construction

7.8.34 Construction works associated with the Weald Brook include:

- Grove bridge loop road crossing and encroachment on riparian corridor of the Weald Brook – clear span crossing
- Maylands bridge A12 slip road crossing of Weald Brook and floodplain – clear span crossing
- Duck Wood bridge northern loop crossing of Weald Brook and floodplain – clear span crossing
- Weald Brook culvert extension approximately 8 m to accommodate carriageway widening
- Construction of Balancing Pond 1 and associated disturbance to landfill
- Discharge of road runoff to natural drainage network and watercourses

7.8.35 During construction there is the potential for deterioration in water quality associated with the risk of run-off from construction areas, accidental spills and ingress of sediment laden water into the Weald Brook. Appropriate pollution control measures will be included with the CEMP and adhered to reduce this risk e.g. pollution prevention measures and CIRIA guidance.

7.8.36 During construction, the required earthworks associated with the loop and slip road would result the loss of riparian, marginal and bankside habitat along the

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watercourse and the creation of three new crossing structures. Bank protection may be required for the Grove bridge loop road crossing which would result in the loss of natural bank profile and associated habitats (including marginal and in channel tree roots).

7.8.37 The footprint and shading effects which would be caused by the new crossing structures are likely to reduce in-channel productivity and cause localised effects on the distribution of aquatic species. The adoption of clear span structures will reduce the potential for negative effects on in-channel habitat connectivity.

7.8.38 The extension of the existing culvert by approximately 8 m to accommodate carriageway widening will result in a small direct loss of open channel, marginal and riparian vegetation, and will contribute slightly to the habitat fragmentation caused by the existing culvert. Required vegetation clearance and earthworks will result in loss of riparian, marginal and bankside habitat from both banks of the Weald Brook within the footprint of the culvert works.

7.8.39 There is the potential for contamination of the Weald Brook to result from construction of Balancing Pond 1 which is sited over an existing landfill at Grove Farm (within 500 m of the Weald Brook). Ground disturbance during construction could mobilise pollutants and open potential impact pathways to surface water receptors through hydrological connectivity.

7.8.40 There is a potential for localised habitat losses (riparian tree clearance) and temporary disturbance to aquatic species associated with proposed mitigation and enhancement works along the Weald Brook.

Operation

7.8.41 No impacts anticipated to arise during the operation of the Scheme. There is potential for pollutant ingress and changes to watercourse hydromorphology resulting from the Scheme will be managed through the new drainage infrastructure, which incorporates treatment and balancing ponds and management of run-off to appropriate discharge rates.

Ingrebourne River

Construction

7.8.42 Construction works associated with the Ingrebourne River include:

- Grove culvert extension by approximately 80 m to accommodate new A12 eastbound off-slip road
- Grove bridge loop road crossing – clear span bridge
- Relocation of A12 eastbound off-slip road
- Construction of Balancing Pond 1 and associated disturbance to landfill
- Discharge of road runoff to natural drainage network and watercourse

7.8.43 During construction there is the potential for deterioration in water quality associated with the risk of run-off from construction areas, accidental spills and ingress of sediment laden water into the Ingrebourne River. Appropriate pollution control measures will be included within the CEMP and adhered to reduce this risk e.g. pollution prevention measures and CIRIA guidance.

7.8.44 The extension of the current culvert approximately 80 m to accommodate the new A12 eastbound off-slip road would result in permanent direct loss of open

channel, marginal and riparian vegetation, and will contribute to habitat fragmentation along the watercourse.

7.8.45 The relocation of the A12 eastbound off-slip road would require a retaining wall on the right bank of the Ingrebourne River which would result in loss of floodplain as well as riparian habitat immediately downstream of the culvert extension location on the right-hand floodplain.

7.8.46 During construction, the required earthworks associated with the Grove bridge loop road would result in the loss of riparian, marginal and bankside habitat from both banks of the Ingrebourne River near to its confluence with the Weald Brook and the creation of a new clear span crossing structure.

7.8.47 There is the potential for contamination of the Ingrebourne River to result from construction of Balancing Pond 1 which is sited over an existing landfill at Grove Farm (within 500 m of the Weald Brook). Ground disturbance during construction could mobile pollutants and open potential impact pathways to surface water receptors through hydrological connectivity.

7.8.48 There is potential for localised habitat losses (riparian tree clearance) and temporary disturbance to aquatic species associated with proposed mitigation and enhancement works along the Ingrebourne River downstream of the culvert extension.

Operation

7.8.49 No impacts anticipated to arise during the operation of the Scheme. There is potential for pollutant ingress and changes to watercourse hydromorphology resulting from the Scheme will be managed through the new drainage infrastructure, which incorporates treatment and balancing ponds and management of run-off to appropriate discharge rates.

Ephemeral ditches

Construction

7.8.50 Construction works to the ephemeral ditches on-site would result in the direct permanent loss of habitat available to opportunistic aquatic species (aquatic macrophytes and macroinvertebrates). Approximately 1,900 m of ephemeral ditches are potentially affected by the Scheme. However, the Scheme will implement an improved drainage system of approximately 3,000 m of new drainage channel, resulting in an overall gain of 1,100 m of ditch.

Operation

7.8.51 No impacts anticipated to arise during the operation of the Scheme. There is potential for pollutant ingress to ditch habitats will be managed through the new drainage infrastructure.

Priority and protected species

Terrestrial invertebrates

Construction

7.8.52 The construction of the Scheme has the potential to lead to the loss of habitat which supports priority invertebrates, such as stag beetle and alder flea-weevil (which are SPI), and those species associated with veteran trees and dead or

dying timbers. In particular the loss of places of shelter, food sources or material for larval development will affect priority invertebrates. Remaining habitat would be separated by the new loop road. These direct impacts are considered to be negative and would be temporary and permanent.

7.8.53 In addition, depending on the timing of the construction works, there could be direct, negative impacts on invertebrates through killing of eggs or larvae which could result in the decline or local extinction of populations of the invertebrate species. This impact could be permanent depending on the size of the populations present within the DCO boundary, and their ability to recover.

7.8.54 Nectar and pollen resources could also temporarily impact pollinators and the predators of pollinators, depending upon the timing of construction works

Operation

7.8.55 There may be impacts on priority terrestrial invertebrates due to damage or pollution events. However, it is unlikely that such infrequent events could cause a decline or local extinction of their populations.

7.8.56 There may also be negative effects on species through inappropriate management of scrub, hedgerow, edge habitat and dead or dying trees.

Great crested newt

Construction

7.8.57 Pond P3, south of the A12 lies 20 m west of proposed gas main diversion. However, P3 is separated from the construction area by the Ingrebourne River. The Ingrebourne River at this location is fast flowing and likely acts as a barrier to the regular dispersal of great crested newts from P3 to habitat west of the watercourse. Impacts to great crested newts south of the A12 are reasonably unlikely.

7.8.58 Construction of the Scheme (new loop road and associated bridges) would result in the permanent loss of approximately 1.9 ha of terrestrial habitat within 250 m of ponds P2, P4 and P5. This represents up to 5 % of terrestrial habitat availability within 250 m of these ponds.

7.8.59 Construction of the Scheme (new loop road, earthworks, clay disposal and gas main diversion) would result in the temporary loss of approximately 5 ha of suitable terrestrial habitat within 250 m of pond P2, P4 and P5. The temporary working areas would be replanted following construction. Temporary loss associated with construction represents 15 % of suitable terrestrial habitat within 250 m of these ponds.

7.8.60 To mitigate the impact of the Scheme on the adjacent Maylands Golf Club, it is necessary to redesign a section of the course in proximity to P2, P4 and P5. This includes the proposed creation of a new green and fairway created north of P2. The design includes the creation of rough grassland and woodland planting on existing fairway areas that will become redundant, and understory planting in an existing plantation woodland. This will result in no net loss of foraging and sheltering opportunities for great crested newt in connection with the golf course mitigation element of the Scheme.

7.8.61 Without mitigation, there is potential for individual great crested newts that are present with the terrestrial habitats to be killed or injured during construction activities associated with the Scheme and associated developments.

Operation

7.8.62 Potential for pollutant ingress resulting from the Scheme will be managed through the new drainage infrastructure, which incorporates treatment and balancing ponds and management of run-off to appropriate discharge rates.

7.8.63 There would also be potential for a direct, permanent impact as a result of the fragmentation of terrestrial habitat. An area of terrestrial habitat suitable for great crested newts (0.3 ha) would lie within the new loop road following construction of the Scheme (within 250 m of P2). The area would not be completely isolated as individual great crested newts would be able to disperse to and from the area via the widespan bridge at the north of the new loop road. However, connectivity between the habitat within the loop and the ponds would be reduced to a narrow corridor. The Scheme does not increase fragmentation in the wider landscape over and above that already caused by presence of the M25 and A12 corridors east and south of the population.

7.8.64 The Scheme introduces a new section of road into terrestrial habitat likely to be used by great crested newt. There is potential for increase in mortality or injury of individual great crested newt as a result of operation of the Scheme.

Reptiles

Construction

7.8.65 Construction of the Scheme would result in the permanent loss of 0.2 ha and temporary loss of 1.5 ha of habitat suitable for common species of reptile. Only low numbers of common lizard have been recorded throughout these habitats. Temporary working areas would be restored and replanted following construction, allowing reptiles to recolonise from areas unaffected by the construction works.

7.8.66 Without mitigation, there is potential for individual reptiles to be harmed or killed during clearance of vegetation and construction works due to cutting of low vegetation, the movement of vehicles, installation of compounds and access routes and topsoil stripping.

Operation

7.8.67 It is expected that any potential impacts from the operation of the Scheme on reptile populations would be negligible.

Birds

Construction

7.8.68 The Scheme could potentially result in a direct, negative impact on bird species as a result of the loss of breeding habitat predominantly associated with the loss of woodland and scrub habitat. Displacement of bird species could occur as a result of habitat loss, noise and visual disturbance from the construction works, but this impact would be temporary, and it is expected that bird species would continue to use suitable habitats within the DCO boundary for breeding upon completion of the works.

7.8.69 In the absence of mitigation, clearance of vegetation could potentially cause harm to nesting birds during construction works.

Operation

7.8.70 Noise and visual disturbance from traffic on the new loop road during the operation of the Scheme may cause permanent displacement of birds to other habitats away from the road.

Bats

Construction

7.8.71 Construction of the Scheme will result in the direct loss of habitat including:

- 30 trees identified as having bat roosting potential will be removed. No roosts have been recorded in these trees to date. However, the removal of these trees represents a loss of potential roosting resource. Without mitigation, there is potential for tree removal to lead to the direct mortality or injury of roosting bats if roosts are present at the time of construction.
- Localised temporary and permanent loss of habitat currently used by foraging bats. This will reduce and disrupt foraging resource available to bats using the Scheme area until replacement habitats become established. This loss includes the permanent shading of habitat along Weald Brook beneath widespan bridges.

7.8.72 Tree 36, with a confirmed bat roost, will be retained during construction.

7.8.73 There is the potential for temporary disruption to foraging bats and disturbance of roosting bats through visual disturbance (vehicle, machinery and workforce), noise disturbance (particularly loud or irregular noises), light disturbance (should night time works take place during the construction period).

Operation

7.8.74 The proposed Scheme includes lighting along the loop road and crosses Weald Brook twice. These features could affect bat foraging routes and access to foraging habitat within the loop road. This potential impact could affect the land within the operational footprint of the Scheme. It is unlikely to affect access to foraging or commuting habitat outside of this area due to the presence of the M25 and A12 corridors.

7.8.75 The proposed Duck Wood bridge, at the north of the loop road, would be widespan and cross Weald Brook 3.8 m at its lowest point. At this height, bats could commute beneath the road to access foraging habitat within the loop[123]. However, the creation of new structures and inclusion of lighting along the proposed loop road could alter bats use of the Scheme and cause bats to permanently avoid areas very close to the new loop road.

Otter

Construction

7.8.76 The realignment of the Ingrebourne River could have a direct and temporary impact on otter that would be negative. There would be temporary disruption of a potential foraging and commuting corridor through the Scheme during construction through loss of habitat and disturbance of individual otter through noise, lighting and other visual stimuli. Taking into account the size of otter home

[123] Highways England, Interim Advice Note 116/08 Nature Conservation Advice In Relation To Bats. Table 8.1.

range and the assumed irregular use of the watercourses by otter, it is anticipated that this temporary disruption to foraging and commuting habitat will only affect part of any individual otter's home range.

7.8.77 No otter resting sites have been found within the study area, and no loss or disturbance of resting sites is anticipated.

Operation

7.8.78 There is potential for otter to be killed or injured on the new roads within the Scheme. In particular, without appropriate design and mitigation, the permanent culvert extension on the Ingrebourne River could discourage otters to use this route, causing them to cross the M25 corridor and junction slip roads to re-join the river.

Badger

Construction

7.8.79 There would be no direct impacts on badger setts as a result of construction. However, the construction of the Scheme would result in both temporary and permanent loss of habitat which supports foraging badgers.

7.8.80 There is potential for noise and disturbance related indirect impacts and potential for harm to badgers foraging within the Scheme during construction.

Operation

7.8.81 Operation of the Scheme may increase the risk of incidental injury and mortality due to the increased footprint of the junction. Widespan bridges over the watercourses through the loop would provide a safe route badgers beneath the new loop road.

7.8.82 Without careful design, any safety fencing required to prevent deer accessing the road could prevent badger accessing foraging and dispersal areas.

Other mammals

Construction

7.8.83 Construction, including Scheme and associated gas main diversion and golf course works, would result in the temporary loss of habitat with potential to support hedgehog and harvest mouse, priority species. Temporary working areas would be restored and replanted following construction, allowing these species to recolonise from areas unaffected by the construction works.

7.8.84 There is the potential for temporary disturbance to hedgehog and harvest mouse through visual disturbance (vehicle, machinery and workforce), noise disturbance (particularly loud or irregular noises) and light disturbance (should night time works take place during the construction period).

Operation

7.8.85 There is potential for an increased risk of mammal casualties during operation of the Scheme.

7.8.86 There is a potential for fallow deer collision to occur as a result of the Scheme. Measures to protect the traveling public from deer collision will be included in the design where necessary. As described in Section 7.7, fallow deer are not a

nature conservation priority and not an important biodiversity receptor in the context of this impact assessment. Therefore, deer collision is not a consideration of this biodiversity impact assessment.

Non-native invasive species

Construction

7.8.87 Himalayan balsam has been recorded on the Ingrebourne River in an area which would be affected by construction of the Scheme. As a result, there is the risk that Himalayan balsam could spread through construction works to the river.

7.8.88 Goats rue and non-native goldenrod were also recorded within the DCO boundary.

7.8.89 Without mitigation or management, construction works could cause the spread of non-native species to other areas of Ingrebourne Valley SMI within and outside of the DCO boundary through the re-use of topsoil, soil/ground disturbance and vehicle movements. This could affect the establishment of habitat reinstatement and creation following construction.

Operation

7.8.90 Inappropriate management could potentially cause the spread of non-native species such as goldenrod.

7.9 Design, mitigation and enhancement measures

7.9.1 The approach to mitigation for impacts on natural conservation resources is to follow the mitigation hierarchy, as follows:

- Avoid – impacts are avoided through measures incorporated into the design and good working practices.
- Mitigate – impacts are reduced where possible to a level that the effect on the nature conservation resource is not significant through measures implemented through the design, construction and operation phases.
- Compensate – impacts that are unavoidable and where mitigation does not reduce the effect to a level that is not significant are compensated for through creation or provision of new resources, such as habitat or places of shelter for animals.

7.9.2 Where impacts cannot be avoided, measures will be used to reduce impacts on biodiversity resources to a level where the overall effect on the resource is not significant. Any additional measures to improve the biodiversity value are considered to be enhancements. Where significant residual effects on a biodiversity resource are predicted after measures to avoid or mitigate for the impacts have been adopted, then measures to compensate for the effect are proposed to be delivered as part of the Scheme.

7.9.3 Biodiversity resources have been taken into account during the development of the design of the Scheme, so that potential impacts can be avoided or mitigated for through appropriate design. As far as is practicable, working within the engineering brief, the Scheme has been designed to minimise the extent of habitat loss, particularly within Ingrebourne Valley SMI. The design takes into account the maintenance of habitat connectivity and commuting routes for

animal species as mitigation for the fragmentation of habitats and reduction of connectivity due to the Scheme.

7.9.4 All the measures described below to avoid, mitigate and compensate for impacts to biodiversity resources are captured in the Register of Environmental Actions and Commitments (REAC) (application document TR010029/APP/7.3). The REAC has been produced to capture all the mitigation commitments for the whole Scheme as part of the ES to inform construction site works and operation of the Scheme. The CEMP prepared by the Principal Contractor during the implementation of the Scheme will be in accordance with the Outline CEMP and will reflect the mitigation contained with the REAC. The CEMP will include the detailed plans and measures to be put in place such as the provision of site briefings and tool box talks for staff, timing of works, protecting animals from harm within the construction area including pre-construction checks, and precautionary methods of working (PMW). An Ecological Clerk of Works (ECoW) will be appointed by the contractor monitor the construction works.

7.9.5 Pollution prevention measures will also be put in place to avoid affecting water quality of watercourses during the construction phase; or impacts on designated sites, Ancient Woodland or retained habitats outside the works area.

7.9.6 In order to ensure the appropriate long-term management of new biodiversity resources provided as mitigation, compensation or enhancements, a Landscape and Ecology Management and Monitoring Plan (LEMP) will be produced and will include details of management works, monitoring and maintenance measures required post-construction. The Outline LEMP is provided in Appendix 7.16. The final version of the LEMP will be substantially in accordance with the management objectives, targets and prescriptions set out in the Outline LEMP (Appendix 7.16).

Terrestrial habitat loss and creation and design context

7.9.7 Table 7.18 below sets out the overall loss and creation/reinstatement of terrestrial habitat within the DCO boundary. For the purposes of this assessment, habitats are described using Phase 1 Survey habitat categories. Terrestrial habitat loss and creation within and outside of designated sites is provided in Table 7.19 and Table 7.20 respectively.

7.9.8 There will be unavoidable temporary and permanent loss of habitat as a result of construction of the Scheme and associated developments. The design of habitat reinstatement and creation within the land temporarily affected has been led by the need to mitigate and compensate for the potential impacts of the Scheme on Ingrebourne Valley SMI, Ingrebourne River, Weald Brook and priority species, and to integrate with the mitigation required for landscape and visual impacts. The Outline LEMP (Appendix 7.16) sets out the aims and objectives for creation and long-term management of new landscape and ecology features within land permanently acquired the Scheme, and targets for the desired long-term condition of these new. These long-term management areas lie within the loop road (along the watercourses) and outside of the loop road (west and north west) where habitat reinstatement and long-term management aims to create a range of habitat suitable for species affected by the Scheme (such as great crested newt, terrestrial invertebrates and bats). Wide-span bridges over watercourses are included in the Scheme design to ensure that animals can move between the areas of land located within and outside of the loop road. The habitat design has taken into account the context of the Scheme, which is bounded to the east and

south by the M25 an A12 corridors, and to the west and north by the open landscape of a golf course, with parkland beyond this. The golf course and parkland include grassland and woodland habitats with ponds throughout. The design is sensitive to the current habitats present within the SMI that lie within the DCO boundary (river corridor, grassland and woodland), and aims to replace and enhance these habitats, including the management and removal of non-native invasive plant species which currently dominate areas within the DCO boundary. Grassland, woodland and scrub habitats will be created, along with a suite of improvements to Weald Brook and Ingrebourne River.

7.9.9 Further detail of the design and specific measures for biodiversity features affected are provided in the designated sites (Ingrebourne Valley SMI), watercourses and species sections below. The Outline LEMP (Appendix 7.16) shows the long-term management areas and includes a description of creation aims and objectives for each habitat type.

Table 7.18: Summary of overall terrestrial habitat loss and habitat creation/reinstatement within the DCO boundary

Habitat	Total area of loss (ha) Linear habitats (m)	Area of reinstatement/ creation (ha)[124] Linear habitats (m)
Semi-natural broadleaved woodland	1	0.0[125]
Broadleaved plantation woodland	2.8	4.7
Mixed plantation woodland	0.1	0.0
Dense scrub	4.8	1.2[126]
Semi-improved neutral grassland	17.2	20.4[127]
Marshy grassland	Not present	0.9
Poor semi-improved grassland	0.1	2.0[128]
Tall ruderal vegetation	0.5	0.0
Tall ruderal (non-native invasive goldenrod)	5.8	0.0
Amenity grassland	2.2	0.0[129]
Bare ground	0.5	0.0
Species rich defunct hedgerow	23 linear metres	20 linear metres
Species poor intact hedgerow	160 linear metres	0 linear metres

[124] The Maylands Golf Club proposals include a small area of land within and outside of Ingrebourne Valley SMI. The proposals for the golf course mitigation works (which will include a variety of grassland and scrub habitats) are not included in the habitat creation / reinstatement calculations and area assumed as permanent loss for the purposes of this assessment. When calculating permanent loss of land within Ingrebourne Valley SMI in section 7.8, this included loss of land to Maylands Golf Club, new road infrastructure which included balancing ponds and highways amenity verge (assumed to be species poor grassland).
[125] All woodland creation will use planted trees. Therefore, using Phase 1 habitat survey terminology, this is listed as 'broadleaved plantation' for the purposes of this assessment. Total woodland loss is 3.8 ha. Total proposed woodland planting is 4.7 ha (slight gain of 0.9 ha).
[126] Scattered scrub and woodland edge habitats are not included in the breakdown of habitats in the calculation of habitat reinstatement/creation
[127] 'Species rich grassland' and 'tussocky grassland' shown on the Preliminary environmental design (Figure 2.2) is taken to be semi-improved neutral grassland for the purposes of this assessment.
[128] 'Highways amenity mix' shown on the Preliminary environmental design (Figure 2.2) on verge areas is taken to be species poor semi-improved grassland for the purposes of this assessment.
[129] Amenity grassland required for the golf course mitigation is not included in this table.

Habitat	Total area of loss (ha) Linear habitats (m)	Area of reinstatement/ creation (ha)[124] Linear habitats (m)
Total	35	29.2

Designated sites

7.9.10 The CEMP will include measures to ensure that storage of materials, construction traffic, dust and pollution do not adversely affect retained habitats in designated sites within or adjacent to the DCO boundary: Ingrebourne Valley SMI, The Oaks LoWS, Lower Vicarage Wood LoWS, Jermains Wood SBI, Tyler's Wood SBI and Folkes Lane Woodland (Upminster) SBI.

Ingrebourne Valley SMI

7.9.11 Construction of the Scheme would result in the unavoidable permanent and temporary loss of terrestrial habitat within Ingrebourne Valley SMI. The Scheme would also involve the shading of sections of Weald Brook, and the extension of a culvert along the Ingrebourne River resulting in the loss of open channel.

7.9.12 Loss of habitat from Ingrebourne Valley SMI will be minimised as much as possible through appropriate construction design that takes into account the importance of the SMI. During construction, habitats within the SMI outside the works area will be retained and appropriately protected to prevent damage and minimise disturbance of species.

7.9.13 The proposed habitat reinstatement and creation is set out on the Preliminary environmental design plans (Figure 2.3). The design of habitat reinstatement and creation has taken into account the current habitats within the SMI that lie within the DCO boundary and the need to mitigate for species affected by the Scheme. The following features have been included in the design:

- Enhancement of Ingrebourne River and Weald Brook (in-channel features, selective coppicing of trees to reduce shade cover, realignment of channel, creation of back waters and lowering of floodplain to create wet grassland habitats (these measures are described in detail in the 'watercourses' section below).
- Widespan bridges to allow movement of species along the river corridors.
- Creation of woodland around the west of the loop road and on embankments to compensate for woodland loss during construction. Woodland will be managed to develop scrub edges to integrate with grassland habitats.
- Grassland creation to provide a richer and more diverse resource of flowering plants. This would include plant families that would benefit a wide range of invertebrates including Fabaceae (especially vetches and trefoils), white Asteraceae (such as ox-eye), yellow Asteraceae (such as hawkweeds) and Apiaceae (carrot family of flowers).
- Creation of tussocky grassland and scrub mix to be managed on rotation to provide a structural diversity for invertebrates, great crested newts, reptiles and birds.

- Meadow areas to be managed with rough margins to create structural diversity and retention of features for invertebrates and other foraging and sheltering species.
- Creation of ponds for great crested newt and specific features such as dead wood habitat for invertebrates.
- Reinstatement of grasslands temporarily affected by construction to provide an increase in the number of species compared to the exiting prior to construction, where possible.
- Control/removal of non-native invasive plant species (early goldenrod) to reinstate grassland habitat and to avoid the spread of this species into other areas of the SMI.
- Appropriate measures to be adopted during establishment to protect woodland, scrub, tree and hedgerow habitats from deer.
- Long-term management of newly created habitats.

7.9.14 Specific mitigation and compensation measures for priority and protected species are set out in the relevant sections below.

7.9.15 A summary of terrestrial habitat loss and gain within Ingrebourne Valley SMI is provided in Table 7.19.

7.9.16 Permanent loss of habitat from Ingrebourne Valley SMI is unavoidable. To compensate for this loss, long-term management of reinstated and existing habitats adjacent to the new loop road will carried out in land permanently acquired for the Scheme. This includes the new woodland planting west of the loop road and four Ecological Compensation Areas (ECAs). ECAs are parcels of land adjacent to the new loop road that will be managed for wildlife (known as ECA A, ECA B, ECA C and ECA D). A LEMP will be produced which will include details of management works, monitoring and maintenance measures required post-construction. The Outline LEMP is provided in Appendix 7.16. The land subject to long-term management is highlighted on the Landscape and ecology management areas drawing (Figure 1) and described within the Outline LEMP (Appendix 7.16).

7.9.17 The Outline LEMP sets out the aims and objectives for creation and management of new landscape and ecology features within the Scheme, and targets for the desired long-term condition of new features to implement the mitigation and compensation measures. Management prescriptions are included for new features that require management beyond the completion of construction of the Scheme in order to meet the target condition.

7.9.18 The inclusion of land for long-term management in the design of the Scheme is proposed in line with The Draft London Plan [130] which states that where harm to non-statutory sites is unavoidable, projects can seek to '*minimise the spatial impact and mitigate it by improving the quality or management of the rest of the site'*. Ingrebourne Valley SMI is a very large site (263 ha). As the potential impacts of the Scheme are localised to the northern extent of the SMI, it is proportionate to focus long-term management of SMI habitat to those areas that are within the DCO boundary where the impacts would occur.

[130] On the 9 December 2019, the London Mayor issued to the Secretary of State the intension to publish the London Plan along with a clean and tracked version of the Intend to Publish London Plan. This plan is available here; https://www.london.gov.uk/sites/default/files/intend_to_publish_-_clean.pdf [accessed December 2019].

Table 7.19: Summary of approximate terrestrial habitat loss and reinstatement within Ingrebourne Valley SMI due to construction of the Scheme

Habitat	Total area of loss (ha) Linear habitats (m)	Area of reinstatement/ creation (ha)[131] Linear habitats (m)
Semi-natural broadleaved woodland	1	0
Broadleaved plantation woodland	2.2	3.1[132]
Mixed plantation woodland	0.1	0
Dense scrub	3.383	1.1
Semi-improved neutral grassland	12.0	14.3[133]
Poor semi-improved grassland	0.1	1.1[134]
Tall ruderal vegetation	0.3	0
Tall ruderal (invasive goldenrod)	5.7	0
Species rich defunct hedgerow	20 linear metres	20 linear metres
Amenity grassland	<0.01	0
Marshy grassland	Not present	0.9
Bare ground	<0.01	0
Total	24.8	20.5

Ancient Woodland

7.9.19 To avoid significant effects on Ancient Woodland, avoidance measures and protection of these resources from disturbance and accidental incursion will be set out in the CEMP.

7.9.20 The location of Ancient Woodland and veteran trees will be identified in the CEMP, which will include mitigation for indirect impacts such as pollution control and protection against damage, such as fencing and buffer areas.

Veteran trees

7.9.21 Veteran trees have been taken into account during the design and all efforts have been taken to avoid impacts or loss of veteran trees.

7.9.22 Measures to protect retained veteran trees throughout construction will be set out in the CEMP. This will include the following measures:

[131] The Maylands Golf Club proposals include a small area of land within the SMI. The proposals for golf course mitigation (which would include grassland and scrub habitats) are not included here and area is assumed as permanent loss for the purposes of this assessment. When calculating permanent loss in section 7.8, this included loss of land to Maylands Golf Club, new road infrastructure which included balancing ponds and highways amenity verge (taken to be species poor grassland).
[132] The proposed design shows a slight net loss of woodland within the SMI (3.0 ha with all three woodland types combined). However, additional woodland is proposed outside of the SMI so that there is no net loss of woodland. Total woodland loss within and outside of the SMI is 3.8 ha. Total proposed woodland planting is 4.7 ha (slight gain of 0.9 ha).
[133] 'Species rich grassland and tussocky grassland' shown on the Preliminary environmental design (Figure 2.2) is taken to be semi-improved neutral grassland for the purposes of this assessment.
[134] 'Highways amenity mix' shown on the Preliminary environmental design (Figure 2.2) on verge areas is taken to be species poor semi-improved grassland for the purposes of this assessment.

- The location of access tracks, haul roads, site compounds and material storage areas will be sited away from retained veteran trees.
- Protection of retained trees following standard practice (i.e. BS 5837:2012 Trees in relation to design, demolition and construction recommendations).
- The retained veteran trees shall be assessed by an arboriculturist prior to construction to inform on any potential remedial works that maybe required to manage any structural or physiological defect(s) that increase the likelihood of full or partial failure of the tree or tree part within falling distance of the works. Veteran habitat features are often defects, meaning any potential works will be sympathetic, whilst being reasonable in order to manage the risk of harm to people or property.

7.9.23 Standing and fallen deadwood have ecological benefits and the approach selected for each of the two veteran trees that cannot be retained will be tailored to maximise the value of any features that can be salvaged through translocation or other means. Arboricultural assessment during detailed design will determine the appropriate approach on an individual tree-by-tree basis. All work will be determined jointly by a suitably qualified arboriculturalist and suitably qualified ecologist, and then supervised on-site by a suitably qualified arboriculturalist.

7.9.24 For each veteran tree lost, eight trees of the same native species will be planted with space around them to develop into an open crown. As, one veteran oak and one veteran ash are lost, 16 trees will be planted. This will include eight oak and, as it is not recommended to plant ash due to ash dieback, eight hornbeam trees. Hornbeam has been selected to replace ash as there are older specimens of this species at the edge of Alder Wood, in nearby Ancient Woodland and it is currently not under threat of disease or damage from pests. The locations of the new trees to be planted will be determined during detailed design.

7.9.25 At least two retained trees within the DCO boundary and selected in consultation with an arboriculturist and ecologist will be ‘veteranised’ to promote dead wood habitat to benefit invertebrates and other specialist wildlife. The trees to be made subject to these works will be determined during detailed design and will be of the broad leaf species as those lost and in an appropriate location to complement the existing veteran tree resource. Examples of veteranisation will include ring-bar king of main stem and/or major limbs to promote heartwood and sapwood decay, coronet cuts and/or deliberate snapping or shattering of limbs to enable ingress of water and subsequently fungal attack and felling of whole trees to be retained in situ to benefit species that prefer deadwood in direct contact with, and under the ground. This includes the SPI stag beetle. To enhance the stag beetle habitat further, at least two large trees that need to be felled will be made in to monoliths. These are large deadwood trunks implanted approximately 1/3 into the ground to provide standing deadwood both above and below the ground surface.

7.9.26 To further compensate for the loss of dead wood habitat for invertebrates, where other (non veteran) trees are felled, some will be retained on-site and repositioned into a range of optimal situations from damp shady situations to full sun to benefit the widest range of invertebrates possible from damp-loving fly species to sun-loving stem-nesting bees and wasps. Locations of repositioned felled trees will also take into account the position of retained veteran trees and need to provide links to between dead wood resources. These felled trees and limbs will be retained in as large a single unit as possible since large volume

pieces of wood remain ecologically viable for a much longer timeframe than sectioned-up material. These trees will not be cut up into rings or sawn up and stacked into log piles.

7.9.27 As part of the need to provide long-term continuity of deadwood resources at the site, innovative techniques supplementary to those outlined above will be undertaken including the planting of a non-native species. It is known that species of tree of the Prunus family (cherries and plums), grow fast and start to die comparatively young and when old, provide a similar rot type to other, slower growing tree species such as oaks. Therefore, a series of Prunus specimens will be planted at strategic woodland edge and open situations in order to provide a stepping stone of deadwood resources between those created through veteranisation and the retained mature specimens of oak and other trees becoming old enough to start producing their own saproxylic features.

7.9.28 Veteran trees and dead wood resources within land retained by the Applicant following construction will be protected during management and maintenance of habitats, to ensure that these resources are not removed (Outline LEMP, Appendix 7.16).

Habitats (outside of Ingrebourne Valley SMI)

7.9.29 Temporary construction areas (contractor's compounds and haul routes) will be reinstated to former habitats after construction. These former habitats will be recreated to provide an increase in the number of species compared to the exiting prior to construction, where possible.

7.9.30 Retained and adjacent habitats will be protected against indirect impacts under measures provided in the Outline CEMP, such as pollution control, fencing and buffer areas.

Table 7.20: Summary of approximate terrestrial habitat loss and reinstatement outside of Ingrebourne Valley SMI due to construction of the Scheme

Habitat	Total area of loss (ha) Linear habitats (m)	Area of reinstatement/creation (ha)[135] Linear habitats (m)
Broadleaved plantation	0.6	1.6
Dense scrub	1.4	0.1
Semi-improved neutral grassland	5.2	6.1[136]
Species-poor hedgerow	160 linear metres	0
Poor semi-improved grassland	0	0.9[137]
Tall ruderal vegetation	0.2	0

[135] The Maylands Golf Club proposals include a small area of land within the SMI. The proposals (grassland and scrub habitats) are not included here and area assumed as permanent loss for the purposes of this assessment. When calculating permanent loss in section 7.9, this included loss of land to Maylands Golf Club, new road infrastructure which included balancing ponds and highways amenity verge.
[136] 'Species rich grassland and tussocky grassland' shown on the Preliminary environmental design (Figure 2.2) is taken to be semi-improved neutral grassland for the purposes of this assessment.
[137] 'Highways amenity mix' shown on the Preliminary environmental design (Figure 2.2 on verge areas is taken to be species poor semi-improved grassland for the purposes of this assessment.

Habitat	Total area of loss (ha) Linear habitats (m)	Area of reinstatement/creation (ha)[135] Linear habitats (m)
Tall ruderal (non-native goldenrod)	0.1	0
Amenity grassland	2.2.6	0
Total	9.7	8.7

Watercourses

7.9.31 Measures are proposed to mitigate the effects of the Scheme on watercourses and ephemeral ditch systems. Details of the mitigation hierarchy align with those reported in the Water Framework Directive Assessment Report (application document TR010029/APP/6.7). The location of each measure is shown on the Preliminary environmental design drawings (Figure 2.2 application document TR010029/APP/6.2) and are summarised here. Measure codes as provided in drawing series (e.g. W02) are included here for clarity.

Embedded mitigation

- Measures will be implemented through the CEMP that act to manage the potential for pollution to watercourses and groundwater (e.g. through fine sediment run-off and accidental spills) to occur through general construction activities, such as adherence to appropriate pollution prevention (PPG/GPP's[138]) and CIRIA guidance[139].
- A fish rescue undertaken by a suitably experienced ecologist will be undertaken for the duration of the in-channel works to ensure that any fish found can be safely caught and returned to unaffected sections of the watercourses. In addition, any pumps to be used for dewatering activities will have mesh installed over their ends to prevent fish species from being sucked into the pumps.
- The works on the Ingrebourne River will avoid the main fish spawning season (March to June).
- Realignment of two sections of existing straight channel to new sinuous courses on the lower Weald Brook. Including the restoration of more natural functioning channel (W02).
- A natural river bed will be incorporated into the design of culverts carrying the Weald Brook under the M25 (Weald Brook Culvert extension) and the Ingrebourne River beneath junction 28 (Grove Culvert extension) (W08).
- Realignment of approximately 170 m of existing straight channel to new sinuous course on the Ingrebourne River, between Grove Farm and the Weald Brook confluence. Including the restoration of more naturally functioning channel (W01).

[138] All pollution prevention guidance (PPGs) that was previously maintained by the Environment Agency has been withdrawn from use. However, in the absence of new guidance the following PPGs should still be used as a source of information on good practice. It is recommended that all works adhere to PPG1 (general guide to the prevention of water pollution); PPG3 (use and design of oil separators in surface water drainage systems); PPG5 (works near or liable to affect watercourses); PPG6 (working at construction and demolition sites) and PPG21 (pollution incident response planning).
[139] CIRIA 2006 Control of water pollution from linear construction projects. Technical guidance (C648).

- Reduction of permanent Scheme footprint on the floodplain within the DCO boundary by supporting the A12 eastbound off-slip road on a retaining wall instead of a large embankment structure which would increase loss of floodplain (W09).
- Proposed crossing structures have been set as high and wide as feasible to limit adverse geomorphological impacts, conveyance and shading effects to Grove bridge, Maylands bridge and Duck Wood bridge (W10).
- Channel crossing and realignments have been planned to limit the need for hard bank protection to reduce potential impacts on aquatic habitats and river morphology at Grove bridge and Duck Wood bridge (W11).
- Management of road runoff before discharge to the natural drainage system (further details within Road Drainage and the Water Environment chapter (Chapter 8) in the ES).

Enhancements

- Lowering of approximately 1,600 m^2 of floodplain, a flood compensation area and creation of a backwater to Weald Brook, just upstream of Duck Wood bridge (W04).
- Lowering of 10,200 m^2 of floodplain connected with Weald Brook in combination with a flood compensation area adjacent to Grove bridge and Maylands bridge (W05).
- Long-term maintenance works to manage riparian trees along the Weald Brook in a way that creates varied light intensity on the channel and riparian zone of the river (W06).
- Lowering of approximately 7,500 m^2 of floodplain, creation of backwaters on the Ingrebourne between Grove Farm and the Weald Brook confluence (W03).
- As part of the Scheme significant lengths of unlined ephemeral drainage ditch will be created to manage ‘clean’ runoff from non-pavement surfaces (W07). These ditches will generate habitat that mitigates for loss of existing ephemeral drainages ditches to the Scheme. Road drainage has been developed to achieve compliance with relevant EQS/RST toxicity and sediment standards as tested with HAWRAT (further details within Road Drainage and the Water Environment chapter (Chapter 8) in the ES).

Additional mitigation (Scheme component specific)

7.9.32 The following specific measures are not captured in the preliminary design as embedded mitigation. They are recorded in the REAC for the Scheme (application document TR010029/APP/7.3), for development in later phases of the design:

- Measures to prevent excessive scour or “wash-out” of bed material immediately downstream of Grove culvert extension and Weald Brook culvert extension (W14). Measures likely to include construction of artificial riffle feature downstream of culvert or selective use of bed and bank protection.

- Measures to facilitate safe mammal passage through Grove (junction 28) culvert and Weald Brook culvert (W15) during higher than normal flows. The form of such measures needs to be determined at detailed design, but often comprise a shelf along which mammals can move, together with ramps for mammal access and egress (this will be included in the existing and extension sections of the culverts).
- Measure to line Balancing Pond No.1. Only required if further Ground Investigations indicate a risk of the leaching of contaminants from the Brook Street Landfill to watercourses (W16).
- Measures outside of the DCO boundary (W13) to enhance riverine habitats elsewhere within the Ingrebourne WFD waterbody (GB106037028130), to be delivered by the Environment Agency (funded by the Applicant).

Priority and protected species

Specific measures for terrestrial invertebrates

7.9.33 Compensation for habitat loss within the designated sites will take into account priority invertebrates so that their habitat requirements are provided. Losses of habitat that may have potential to be rich in invertebrate resources will also be avoided where possible. Mitigation measures during construction will be addressed in the CEMP. In conjunction with the need to provide replacement habitats and features for the saproxylic resources, the principal that will drive the broader terrestrial invertebrate mitigation, will be the need to create a landscape that is varied with a strong emphasis on niche availability and structural complexity with interfaces between scrub and open grassland to produce lots of situations in which scarce and threatened species can live. The target is the tall grassland and scrub edge resource (see Table 7.11). Examples of the proposed mitigation will include:

- Creation of flower-abundant grassland wherever possible and feasible such as on the mitigation area and new earthworks through careful use of topsoil, appropriate seed mixes and management.
- The grassland will include a wide range of flowering plant species and flower types from open, broad flat flowers to species with deep corollas. The grassland will then benefit a wide range of pollinators from short-tongued flies and beetles to long-tongued solitary bees and bumblebees.
- An issue that is becoming more prevalent is the early advent of spring. In the southeast of England an early ‘false’ spring is starting to become the norm and in recent years high February and early March temperatures encourage some invertebrates out of hibernation. However, our botanical flora has not yet adapted to this and is leaving early spring flying invertebrates with a reduced nectar resource. To help mitigate these effects of climate change the planting of the early flowering cherry plum as part of scrub planting will be undertaken.
- The ECA B will include areas of scattered and dense scrub. The scrub diversity will all be spring blossom species and provide a continuity of nectar and pollen resources from February through to early June, after which the grassland plants will become the dominant floral resource.

- The grassland and scrub matrix (ECA B) will include piles of deadwood or small clusters of standing deadwood posts in sunny situations. This desiccated deadwood resource will benefit stem-nesting bees and wasps, of which the surrounding area may hold a currently undetected but valuable resource.
- Where possible, alder will be planted in suitable damp ground and watercourse edge situations as part of measures to provide suitable habitat for the alder flea weevil (SPI) that may potentially be present.
- Grassland, scrub, edge habitat, dead or dying trees and dead wood features will be managed appropriately to ensure they provide suitable habitat and conditions for invertebrates (see Outline LEMP, Appendix 7.16).

Specific measures for great crested newt

Population south of A12

7.9.34 Pond P3 is separated from the construction area by the Ingrebourne River. The Ingrebourne River at this location is a perennially flowing watercourse and likely acts as a barrier to the regular dispersal of great crested newts from P3 to habitat west of the watercourse. Impacts to great crested newts south of the A12 are reasonably unlikely. However, any activities south of the A12 will be carried out sensitively under a written Precautionary Method of Working which will detail measures and steps to be taken to minimise any potential impacts to individual great crested newts south of the A12.

Population in northwest area of the Scheme

7.9.35 Given the proximity of the proposed construction areas to pond P2, P4 and P5, construction works would take place under a European Protected Species (EPS) mitigation licence from Natural England.

7.9.36 Habitat immediately around pond P2 will be retained and protected throughout construction.

7.9.37 Habitat reinstatement and creation will take place in working areas close to ponds as soon as possible following completion of construction.

7.9.38 Due to the proximity of the works to pond P2, exclusion and translocation of great crested newts may be required. The timing and methods of site clearance, protection of individual newts, habitat enhancement and habitat creation would follow an EPS mitigation licence method statement to be agreed with Natural England prior to commencement of construction.

7.9.39 As compensation for permanent habitat loss associated with construction of the new loop road, and reduction in dispersal opportunities to areas of land retained within the loop road, habitat within the field surrounding pond P2 will be enhanced and managed as part of ECA B. This will include:

- Habitat creation following temporary works including tussocky grassland and scrub mix
- Management of retained habitat to control and remove non-native goldenrod and restore grassland
- Lowering of land to create wet grassland habitat for foraging

- Creation of hibernation and sheltering opportunities using arisings from site clearance (logs)
- Creation of two new ponds (to be lined appropriately if necessary)
- Restoration of P2 to remove silt build up to provide potential for the pond to retain water longer in the season

7.9.40 The two proposed ponds would be designed to be suitable for breeding great crested newt. They would be positioned within the slope and fed by rain water similarly to existing pond P2. The detailed design will consider the need to line the ponds depending on existing ground conditions so that they are more likely to retain water throughout the breeding season. The ponds will not be connected to the existing drain running through ECA B, to avoid any contaminants (such as fertiliser) from the adjacent golf course entering the ponds.

7.9.41 The terrestrial and aquatic habitat in ECA B will be managed appropriately for great crested newts under a LEMP (Outline LEMP provided in Appendix 7.16).

7.9.42 The enhancement of habitat within ECA B will provide a benefit to the meta-population within and adjacent to the Scheme around Dagnam Park and The Manor LNR, by increasing breeding opportunities and securing terrestrial habitat at the southeast extent of the population.

7.9.43 Great crested newt typically use suitable terrestrial habitat up to 500 m from a breeding pond. Study has shown that providing good quality habitat is present around the pond, the abundance of great crested newts in terrestrial habitat reduces over 100 m from the pond, with a considerable drop in abundance at 250 m[140]. Provision of habitat enhancements in ECA B within 100 m of pond P2 will reduce the risk of great crested newt dispersal onto the carriageway of the new loop road. Any fatality of great crested newt is likely to be incidental only.

7.9.44 To mitigate the effect of the Scheme on the adjacent Maylands Golf Club, it is necessary to redesign a section of the course in proximity to P2. A new green and fairway will be created north of P2. Great crested newts are present in and around the existing golf course, and can disperse across the well managed green areas, and find shelter and foraging opportunities in the rough grassland and scrub habitats. To ensure there is no net loss of foraging and sheltering opportunities in relation to the redesign of the golf course, the creation of a new green/fairway will be compensated for by creating rough grassland and woodland habitats on existing green and fairway areas which would become redundant, and understory planting in existing plantation woodland on the golf course.

Specific measures for reptiles

7.9.45 Low numbers of common lizard have been recorded, and it is assumed low numbers of grass snake are present. To avoid direct harm to reptile species construction activities A reptile mitigation strategy will be created during detailed design (prior to construction) to avoid harm to low numbers of reptiles present within the DCO boundary. This will include identification of areas of habitat to retain within the DCO boundary outside of the temporary construction footprint and methods to reduce harm to individual reptiles (such as habitat manipulation to temporarily displace reptiles from the construction footprint). This will be set

[140] Cresswell, W. & Whitworth, R. (2004) English Nature Research Reports Number 576: An assessment of the efficiency of capture techniques and the value of different habitats for the great crested newt Triturus cristatus. English Nature, Peterborough.

out in a PMW which will be included in the CEMP. Where necessary, additional reptile surveys will be carried out prior to construction (this will be detailed in the reptile mitigation strategy).

7.9.46 The creation of grassland and scrub habitats in ECA B, which includes the management and removal of non-native goldenrod) will provide suitable habitat for reptiles to colonise following creation. This terrestrial habitat and log piles and hibernacula created for great crested newts will also benefit reptiles.

Specific measures for birds

7.9.47 To avoid impacts on nesting birds, vegetation clearance will be undertaken outside of the bird breeding season (March to August inclusive). Where this is not achievable, then a PMW will be adopted to ensure that no bird nests are disturbed or destroyed. Such vegetation removal will be supervised by a competent ECoW and if any active bird nests are identified, works will be stopped and the bird nest clearly marked off with a suitably sized buffer. Only once confirmed that the young have fledged would works continue within the buffered area.

7.9.48 Starling nest boxes will be installed to help to encourage starling to breed within the Scheme, as only one starling territory was recorded within the Scheme. Additional bird nesting boxes will be installed on suitably mature trees, at least 5 m above ground. Nest boxes will provide further nesting opportunities for birds within the Scheme.

7.9.49 Bird nest boxes will be provided to compensate for the loss of potential nesting opportunities within the DCO boundary. This will include a variety of box designs, including designs suitable for starling. The exact locations of these nest boxes will be determined during detailed design and recorded in the CEMP.

Specific measures for bats/potential bat roosts

7.9.50 The number of trees to be removed within the DCO boundary will be kept to a minimum, avoiding trees with potential to support roosting bats (categorised as either low, moderate or high potential) where possible. Tree removal will follow a PMW in relation to bats that incorporates the following measures:

- Updated survey to check for roosting bats in trees will be carried out at all trees requiring removal for construction or that lie within 50 m of construction.
- Removal of trees with potential for roosting bats will be undertaken in either spring (mid-March to the end of April) or autumn (September to late October), to avoid the periods before the young are weaned and independent and the hibernation period.
- All trees with high, moderate or low potential that need to be removed will be subject to a climbing inspection by a bat licenced ecologist immediately prior to removal to confirm bats are absent. If the tree cannot be felled on the same day, and bats are absent, the feature will be blocked to prevent use in the interim period prior to felling. If bats or evidence of a roost is found at any point then measures to protect individual bats and maintain roosting opportunities would be put in place and a licenced bat ecologist will be contacted to reassess the situation including, if required, applying for an EPS mitigation licence.

7.9.51 These measures apply to roost at Tree 36 which will be retained during construction. Pre-construction and during construction surveys will be carried out as necessary, and measures put in place to protect the roost from visual and noise disturbance. A licenced bat ecologist will reassess the situation as necessary including, if required, applying for an EPS mitigation licence.

7.9.52 To mitigate for the loss of potential roosting features, bat boxes will be installed in retained woodland at Alder Wood, The Grove and along Weald Brook at suitable locations identified by an ecologist. Bat boxes will be installed on suitable retained mature trees, approximately 5 m above ground. Boxes will face in a southerly direction, although in each wood a cluster of three boxes will be placed facing different directions to help create a variety of micro habitats. Bat boxes will be long-lasting designs (such as Schwegler wood-crete boxes) and a variety of boxes will be selected suitable for the bat species recorded within the Scheme. The exact locations of these boxes will be determined during detailed design and recorded in the CEMP.

7.9.53 Night working will be avoided where possible. Where temporary lighting is required for construction, it would be designed sensitively to avoid illuminating adjacent habitats used by commuting and foraging bats such as watercourses, hedgerow and woodland and scrub edges. During the bat active seasons, a dark corridor will be retained along Weald Brook throughout the works. Due to the proximity of suitable roosting, foraging and commuting habitats surrounding the construction footprint, measures to reduce light spill into adjacent habitat will be incorporated into the CEMP.

7.9.54 The Preliminary environmental design (Figure 2.2) includes the creation and reinstatement of woodland, scrub, grassland, hedgerow and ponds which will provide foraging areas for bats. These habitats and the Weald Brook corridor through the Scheme will be appropriately managed for use by foraging and commuting bats.

7.9.55 Operational lighting will designed in accordance with best practice guidelines[141] taking into consideration the presence of commuting and foraging bats and other wildlife, including measure to avoid and minimise light spill onto adjacent habitat, particularly woodland and the Weald Brook.

Specific measures for otter and water vole

7.9.56 Pre-construction surveys will be carried out on watercourses to check for the presence of otter and water vole.

7.9.57 No otter resting sites have been recorded within the survey area. If an otter resting site is identified, either along a watercourse or within terrestrial habitat to be removed or disturbed by the works, then works will be conducted under a Natural England mitigation licence and led by a suitably experienced otter ecologist. Specific mitigation measures will be incorporated dependent on the status of the resting site, such as the installation of an artificial holt, implementation of exclusion zones or postponing of works until breeding activity has ceased.

7.9.58 The temporary disruption of the watercourses, particularly the Ingrebourne River, is unavoidable during construction. However, a dark corridor will be maintained along Weald Brook and the Ingrebourne River throughout construction to

[141] Institute of Lighting Professionals and Bat Conservation Trust (2018). Guidance Note 08/18. Bats and artificial lighting in the UK. Bats and the Built Environment Series.

minimise disturbance to otter or other mammals moving along the river corridors. Should survey work and monitoring prior to and during construction identify the need for additional measures to protect individual otter (e.g. if regular use of the watercourses by otter is recorded), appropriate measure will be employed (such as temporary otter proof fencing during any higher risk construction operations).

7.9.59 Open excavations will be suitably fenced to prevent otters falling in. These measures will be detailed in the CEMP.

7.9.60 The realignment of the Ingrebourne River will be designed as naturally as possible to provide suitable foraging and commuting habitat for otter. The design will include resting areas for otters and scrub planting to provide shelter for this species. This design will also benefit water voles should they colonise the Ingrebourne River in the future.

7.9.61 Selective coppicing of trees along Weald Brook will be implemented to allow for aquatic plants to colonise the channel and the banks to become colonised by aquatic and marginal species. This would provide more suitable habitat for both otter and water vole within the DCO boundary.

7.9.62 The provision of wide-span bridges over the watercourses is designed to maintain habitat connectivity for animals along Weald Brook, including otter and water vole. Safe mammal passage through junction 28 culvert is included in the design. This includes safe passage not just through the culvert extension, but through the length of the existing culvert. Safe mammal passage will also be added to the existing Weald Brook culvert and very short extension required at that location. Detailed design will take into account existing use of the culvert by mammals. Exclusion fencing will be incorporated as appropriate to prevent otter accessing highways.

Specific measures for badgers

7.9.63 To ensure that badgers are not adversely affected by the Scheme, sufficient connectivity for badgers commuting between the known main sett and outlier setts within the Scheme will be maintained as part of the design of the wide-span bridges crossing over the watercourses. Additionally, access for badgers to the box culvert where the Ingrebourne River flows under the M25 will be maintained. The presence of badger will be taken into account during detailed design of any road safety requirements (such as deer fencing).

7.9.64 To minimise impacts on badgers during the construction phase, suitable buffer zones will be set up around any setts and appropriate signage provided. This will ensure construction activities do not disturb setts, and materials are not stored within buffer zones. Where works are unavoidable close to setts then a PMW will be followed, or the works undertaken under licence. Night-time working will consider the presence of badgers commuting and foraging across the working area, and any open excavations will be suitably fenced to prevent badgers falling in. These measures will be detailed in the CEMP.

7.9.65 Operational lighting will be sensitively designed to avoid disturbance of badgers.

Specific measures for other priority mammals

7.9.66 The habitat reinstatement and creation measures would provide a variety of habitats for hedgehog and rough grassland habitat suitable for harvest mouse. It is anticipated that these species (if present) would re-colonise the Scheme following establishment of habitats.

7.9.67 Widespan bridges over the Weald Brook would allow mammals to safety disperse to habitat which will be retained within the loop road. However, there remains an incidental risk that individual mammals such as hedgehog and harvest mouse (if present) could be killed on the new carriageway. Individual occurrences are unlikely to affect the local population of these species.

Non-native invasive species

7.9.68 A method statement for the management and removal of goldenrod and Himalayan Balsam will be produced and implemented to avoid the spread of these species within and outside the DCO boundary, avoid the spread into further areas of Ingrebourne Valley SMI and to protect reinstated and created habitats from colonisation. This requirement is included in the Outline CEMP and will include a surveys to be carried out prior to construction to map and identify locations of these non-native species to determine the most appropriate approach to management based on the construction programme. This may include management, treatment and removal, excavation and treatment of topsoil or other measures considered appropriate by a specialist contractor.

7.9.69 Post scheme completion, on-going measures to check and control non-native goldenrod and other invasive plant species will be included in the LEMP.

7.9.70 Measures for the appropriate management and humane removal of invasive species of animals, such as signal crayfish, will be included in the CEMP should they be encountered during construction works.

7.10 Assessment of effects

7.10.1 Taking all mitigation and compensation measures into account, the likely effects of the Scheme on biodiversity resources have been determined as part of this assessment. These are summarised in Table 7.21 overleaf.

Table 7.21: Summary of residual effects on biodiversity resources

Biodiversity resource	Value	Summary of potential impacts	Impact characterisation	Summary of proposed mitigation/ compensation	Residual effect	Significance
Ancient Woodland	National	Construction Potential pollution impacts.	Temporary	Standard pollution prevention measures included in the CEMP.	Unlikely to have a significant effect on conservation status.	Neutral
		Operation Incidental damage, pollution events, or changes in air quality.	Small-scale and temporary	Pollution prevention measures provided in the design.	Unlikely to have a significant effect on conservation status.	Neutral
Veteran trees	County or Unitary Authority Area	Construction Loss of two veteran trees.	Permanent	A departure from Highways Standards has been proposed to allow the retention of Tree T059. Veteran trees that are lost will be replaced with suitable native species (eight trees for each tree removed, total of 16) Retained veteran trees will be protected. Measures to provide continuity of dead-wood resource for invertebrates proposed including veteranisation of existing trees, retention of felled trees and planting of suitable tree species.	Significant effect on the conservation status due to loss of trees.	Moderate adverse
		Operation Incidental damage, pollution events, or changes in air quality.	Temporary	Pollution prevention measures provided in the design.	Unlikely to have a significant effect on conservation status.	Neutral

Biodiversity resource	Value	Summary of potential impacts	Impact characterisation	Summary of proposed mitigation/ compensation	Residual effect	Significance
The Manor LNR	County or Unitary Authority Area	No impacts identified	N/A	None required.	No effects.	Neutral
Ingrebourne Valley SMI	County or Unitary Authority Area	Construction Loss of 9.4% of terrestrial habitat during construction, of which 2% would be permanent. Loss primarily of woodland, scrub, semi-improved grassland and the shading of watercourses. Changes to local hydrology and water quality. Ground and surface water pollution, noise and visual disturbance.	Permanent and temporary	Habitat loss from the SMI will minimised. Habitat within the SMI that is outside of the works area will be retained and protected. Mitigation for pollution and disturbance in the Outline CEMP. Woodland and grassland habitat will be replaced on new earthworks, around new ponds and elsewhere within the Scheme. Enhancement of Ingrebourne River and Weald Brook within the Scheme. Widespan bridges to allow movement of species along river corridors. Control / removal of non-native goldenrod to reinstate grassland habitat. To compensate for permanent loss of land within SMI, long-term management of reinstated and exiting habitats adjacent to the new loop road will be carried out in areas permanently acquired for the Scheme under a LEMP.	Significant adverse effect on the conservation objectives of the SMI within the vicinity of the Scheme until new habitats become established. Permanent loss of 2% of SMI can not be avoided.	Moderate adverse becoming slight adverse on establishment of mitigation and compensation habitat.

Biodiversity resource	Value	Summary of potential impacts	Impact characterisation	Summary of proposed mitigation/ compensation	Residual effect	Significance
		Operation Noise, lighting and visual stimuli. Incidental damage, or changes in air quality.	Permanent	Pollution prevention measures provided in the design. LEMP to manage ECAs and replacement habitat in the long-term.	Unlikely to have a significant residual effect on the conservation objectives of the SMI. However, as a precaution, significance of effect assigned as slight adverse.	Slight adverse
Other non-statutory designated sites	County or Unitary Authority Area	Construction Potential ground and surface water pollution, noise and visual disturbance.	Small-scale, temporary	Mitigation for pollution and disturbance in the Outline CEMP.	Unlikely to have a significant effect on the conservation objectives of these sites.	Neutral
		Operation Due to proximity of these habitats to the existing road infrastructure, effects over and above those currently experienced by these habitats are unlikely.	N/A	None required.	Neutral	Neutral
Weald Brook	County or Unitary Authority Area	Construction (general): Potential for deterioration in water quality associated with the risk of run-off from construction areas, accidental spills and ingress of sediment laden water.	Permanent and temporary	Mitigation: Adoption and adherence to pollution prevention measures and best practice guidance to control the risk of pollution of surface and ground water – as listed in Outline CEMP. Realignment of two sections of existing straight channel on the lower Weald Brook (W02). Works will include appropriate measure to prevent harm to aquatic receptors within sections to be realignment.	With mitigation and enhancement measures implemented, residual effects of the Scheme on the Weald Brook and associated aquatic species are not anticipated. Channel realignment works and floodplain enhancement are considered to adequately mitigate for the	Slight adverse becoming Neutral on establishment of mitigation features
		Construction: Temporary disturbance to, and permanent loss of floodplain and riparian corridor habitat resulting from combination of Grove				

Biodiversity resource	Value	Summary of potential impacts	Impact characterisation	Summary of proposed mitigation/ compensation	Residual effect	Significance
		bridge loop road and A12 eastbound offslip road clear span crossings. Permanent effects on in-channel, riparian and floodplain habitat complexity resulting from footprint and shading effects of new crossings. Reduction in riparian connectivity and increase in habitat fragmentation.		Incorporation of natural bed into the design of the Weald Brook Culvert extension (W08). Minimising A12 footprint by construction of a retaining wall instead of a large embankment structure (W09). Crossing structures have been set as high and wide as feasible to limit adverse geomorphological and ecological impacts (W10) and have been planned to limit the need for hard bank protection (W11). Lining of Balancing Pond No.1. if GI indicates a risk of the leaching of contaminants from the Brook Street Landfill to watercourses (W16). Measures to prevent excessive scour or "wash-out" of bed material immediately downstream of the Weald Brook culvert extension (W14) and measures to facilitate mammal passage through the extended culvert footprint (W15). Enhancement: Lowering of c 1,600 m^2 of floodplain, a flood compensation area and creation of a backwater to	permanent footprint of the Scheme.	
		Construction: Temporary disturbance to, and permanent loss of floodplain and riparian corridor habitat resulting from Duck Wood bridge northern loop clear span crossing. Permanent effects on in-channel, riparian and floodplain habitat complexity resulting from footprint and shading effects of new crossing. Reduction in riparian connectivity and increase in habitat fragmentation.				
		Construction: Temporary disturbance to, and permanent loss of open watercourse channel and riparian corridor resulting from 8 m				

Biodiversity resource	Value	Summary of potential impacts	Impact characterisation	Summary of proposed mitigation/ compensation	Residual effect	Significance
		extension of exiting Weald Brook culvert. Slight increase in extent of habitat fragmentation and small loss of habitat availability for aquatic and marginal species as a result of culvert placement.		Weald Brook, just upstream of Duck Wood bridge (W04). Plus, lowering of 10,200 m^2 of floodplain in combination with a flood compensation area adjacent to Grove bridge and Maylands bridge (W05). Long-term maintenance works to manage riparian trees along the Weald Brook in a way that creates varied light intensity on the channel and riparian zone of the river to improve condition for macrophytes (W06).		
		Construction: Potential for pollution of the Weald Brook resulting from disturbance of land fill associated with Balancing Pond 1 and ingress to watercourse via groundwater connectivity.				
		Operational: Potential for pollution ingress to watercourses and negative effects on habitats and species associated with discharges from new road infrastructure. Including changes to watercourse hydromorphology.	Temporary to permanent (depending on severity of pollution event)	Provision of new drainage infrastructure which provides management of road run-off quality and the adoption of balancing ponds.	Unlikely to have a significant effect on the watercourse habitat and/or associated aquatic species.	Neutral
Ingrebourne River	County or Unitary Authority Area	Construction: Temporary disturbance to, and permanent loss of open watercourse channel and riparian corridor resulting from 80 m extension of Grove culvert.	Permanent and temporary	Mitigation: Adoption and adherence to pollution prevention measures and best practice guidance to control the risk of pollution of surface and ground water – as listed in CEMP.	Despite the mitigation and enhancement package (realignment, backwaters and floodplain measures) associated with the Ingrebourne River, the residual effect of the	Moderate adverse within the DCO boundary – in relation to the permeant loss

Biodiversity resource	Value	Summary of potential impacts	Impact characterisation	Summary of proposed mitigation/ compensation	Residual effect	Significance
		Increase in extent of habitat fragmentation and loss of habitat for aquatic and marginal species as a result of culvert placement. Construction: Temporary disturbance to, and permanent loss of floodplain and riparian corridor habitat resulting from Grove bridge loop road crossing clear span bridge structure. Permanent effects on in-channel and riparian habitat complexity resulting from shading effects of structure due to the low level of the deck height. Reduction in riparian connectivity and increase in habitat fragmentation. Construction: Temporary disturbance to, and permanent loss of floodplain and riparian habitat as a result of A12 eastbound off-slip road alignment. Construction: Potential for pollution of the Ingrebourne River resulting from disturbance		Incorporation of natural bed into the design of the Grove Culvert extension (W08). Minimising A12 eastbound on-slip footprint by construction of a retaining wall instead of a large embankment structure (W09). Crossing structures have been set as high and wide as feasible to limit adverse geomorphological and ecological impacts (W10) and have been planned to limit the need for hard bank protection (W11). Measures to prevent excessive scour or “wash-out” of bed material immediately downstream of the Grove culvert extension (W14) and measures to facilitate mammal passage through the extended culvert footprint (W15). Lining of Balancing Pond No.1. if GI indicates a risk of the leaching of contaminants from the Brook Street Landfill to watercourses (W16). Enhancement: Realignment of c 170 m of existing straight channel to new sinuous course between Grove Farm and the Weald Brook confluence i.e. downstream of the culvert	permeant loss of open water and riparian habitat caused by the 80 m culvert extension is significant within the DCO boundary. The concomitant increase in habitat fragmentation caused by the culvert extension and new Grove bridge loop road crossing are assessed as having a long-term negative effect on the watercourse habitat and habitat availability for aquatic species within the DCO boundary. Measures to off-set this residual effect within the DCO boundary with enhancement of riverine habitats elsewhere within the Ingrebourne WFD waterbody (GB106037028130) will be delivered by the Environment Agency, funded by the Applicant.	of open water habitat only. Neutral in relation to Ingrebourne WFD waterbody (taking into account off-site works)

Biodiversity resource	Value	Summary of potential impacts	Impact characterisation	Summary of proposed mitigation/ compensation	Residual effect	Significance
		of land fill associated with Balancing Pond 1 and ingress to watercourse via groundwater connectivity.		extension. Including the restoration of more naturally functioning channel (W01). Lowering of approximately 7,500 m^2 of floodplain, creation of backwaters on the Ingrebourne between Grove Farm and the Weald Brook confluence (W03).		
		Operational: Potential for pollution ingress to watercourses and negative effects on habitats and species associated with discharges from new road infrastructure. Including to changes to watercourse hydromorphology.	Temporary to permanent (depending on severity of pollution event)	Provision of new drainage infrastructure which provides management of road run-off quality and the adoption of balancing ponds.	Unlikely to have a significant effect on the watercourse habitat and/or associated aquatic species.	Neutral
Ephemeral ditches	Local	Construction (general): Potential for deterioration in water quality associated with the risk of run-off from construction areas, accidental spills and ingress of sediment laden water.	Permanent and temporary	Mitigation: Adoption and adherence to pollution prevention measures and best practice guidance to control the risk of pollution of surface and ground water – as listed in CEMP. Approximately 3,000 m of unlined ephemeral drainage ditch will be created to manage run-off from non-pavement surfaces (W07). Therefore, a net gain of 1,100 m of this habitat typology will result from the Scheme, providing an increase in the	Unlikely to have a significant effect on the conservation objectives of these sites.	Neutral
		Construction: Permanent loss of 1,900 m ephemeral ditch habitat and associated aquatic species under the footprint of the Scheme earthworks. Habitat is considered to provide only limited value				

Biodiversity resource	Value	Summary of potential impacts	Impact characterisation	Summary of proposed mitigation/ compensation	Residual effect	Significance
		to aquatic receptors due to intermittent nature of flow within the existing ditch network.		extent and distribution of habitat for opportunistic aquatic species during times of flow.		
		Operational: Potential for pollution ingress to ditch habitat and negative effects on species associated with discharges from new road infrastructure.	Temporary to permanent (depending on severity of pollution event)	Provision of new drainage infrastructure which provides management of road run-off quality.	Unlikely to have a significant effect on the watercourse habitat and/or associated aquatic species.	Neutral
Other habitats outside of Ingrebourne Valley SMI Broadleaved plantation woodland Semi-improved grassland Species-poor hedgerow Ponds	Local	Construction Loss of 9.2 ha of habitat including broadleaved plantation woodland, semi-improved grassland and species poor hedgerow.	Permanent and temporary	Habitat loss will be minimised and habitat outside the works area will be retained and protected. Mitigation for pollution and disturbance in the Outline CEMP Temporary construction areas will be reinstated to former habitats after construction. These former habitats will be recreated to provide an increase in the number of species compared to the exiting prior to construction (e.g. use of flower-abundant grassland mixes).	Adverse effect on the conservation status of habitats until new habitats become established.	Slight adverse becoming Neutral on establishment of mitigation and compensation habitat.
		Operation Incident damage, pollution events, or changes in air quality.	Temporary	Pollution prevention measures provided in the drainage design. LEMP to manage replacement habitat in the long-term.	Neutral	Neutral

Biodiversity resource	Value	Summary of potential impacts	Impact characterisation	Summary of proposed mitigation/ compensation	Residual effect	Significance
Terrestrial invertebrates (including stag beetle and alder flea-weevil)	County or Unitary Authority Area	Construction Loss of habitat and harm to adults, eggs and larvae.	Permanent and temporary	Habitat loss will be minimised and habitat outside the works area will be retained and protected. Woodland, wood edge and flower-abundant grassland habitat will be replaced on new earthworks, around new ponds and elsewhere within the Scheme. New habitat within the ECAs will benefit invertebrates and be managed appropriately in line with the Outline LEMP To provide continuity of deadwood habitat, felled trees will be retained appropriately, trees will veteranised. Cherry plum will be planted to provide an important foraging resource for invertebrates in early spring.	Significant adverse effect on the conservation status of invertebrate species until new habitats become established.	Moderate adverse becoming Neutral on establishment of mitigation and compensation habitat.
		Operation Incident damage or pollution events.	Temporary	Pollution prevention measures provided in the design. LEMP to manage ECAs and replacement habitat in the long-term.	Unlikely to have a significant effect on conservation status of the population.	Neutral
Great crested newt	County or Unitary Authority Area	Construction Loss of a proportion of terrestrial habitat. Fragmentation of habitat. Harm to individuals. No impacts on the great crested newt population	Permanent and temporary	Site clearance, construction, habitat creation and habitat enhancement would take place under an EPS mitigation licence. Pond P2 to be retained, protected and enhanced/restored.	Unlikely to have a significant effect on conservation status of great crested newt populations.	Slight adverse becoming Neutral on establishment of habitat

Biodiversity resource	Value	Summary of potential impacts	Impact characterisation	Summary of proposed mitigation/ compensation	Residual effect	Significance
		adjacent to the Scheme south of the A12.		Compensation habitat for great crested newts in the ECA B will result in additional breeding habitat (at least two ponds, restoration of existing pond P2) and improved terrestrial habitat. This will benefit the meta-population northwest of the Scheme. Wide-span overbridges allow dispersal of newts to land within the new loop road. Appropriate redesign of golf course ensure there is no net loss of foraging and sheltering opportunities. Construction south of the A12 and on land over 250 m from ponds would be carried out sensitively under a PMW to protect individual newts which may be present.		
		Operation Pollution of watercourses.	Temporary or permanent	Provision of habitat enhancement close to P2 to reduce likelihood of dispersal across the new carriageway reducing mortality of individuals to incidental levels only. LEMP to manage ECA and replacement habitat in the long-term.	Unlikely to have a significant effect on conservation status of these populations.	Neutral
Reptiles	Local	Construction Loss and fragmentation of habitat.	Temporary and permanent	Habitat loss will be minimised and habitat outside the works area will be retained and	Unlikely to have a significant effect on	Neutral

Biodiversity resource	Value	Summary of potential impacts	Impact characterisation	Summary of proposed mitigation/ compensation	Residual effect	Significance
		Harm to individuals.		protected. Site clearance will be carried out under a PMW to protect individual reptiles from harm. Habitat will be replaced on new earthworks, around new ponds and elsewhere within the Scheme; and retained grassland habitats will be enhanced. This mitigation and new habitat within the ECAs will benefit reptiles.	conservation status of reptile populations.	
		Operation Negligible impacts.	N/A	None required.	Unlikely to have a significant effect on conservation status of these populations.	Neutral
Birds (including kingfisher)	Local	Construction Habitat loss. Displacement due to noise and visual disturbance. Harm to nesting birds, eggs or young.	Temporary and permanent	Habitat loss will be minimised and habitat outside the works area will be retained and protected. Habitat replacement, compensation and enhancements will benefit bird species. Nest boxes will be provided to compensate for the loss of nesting opportunities during construction.	Unlikely to have a significant effect on conservation status of bird populations.	Slight adverse becoming Neutral on establishment of habitat
		Operation Displacement due to noise and visual disturbance.	Permanent	LEMP to manage ECA and replacement habitat in the long-term.	Unlikely to have a significant effect on conservation status of bird populations.	Neutral

Biodiversity resource	Value	Summary of potential impacts	Impact characterisation	Summary of proposed mitigation/ compensation	Residual effect	Significance
Bats	Local	Construction Reduction in foraging resource with temporary loss and disruption of foraging and commuting areas. Loss of trees with roosting potential. Potential temporary disturbance (noise/light/visual) of roosts.	Temporary and permanent	Where practicable, removal of trees with potential to support roosting bats will be avoided. Trees with potential to support roosting bats will be checked for the presence of roosting bats prior to removal. A variety of bat boxes will be placed at suitable locations in The Grove, Alder Wood and along Weald Brook to mitigation for the loss of potential roosting features. Where temporary lighting is required for construction, it would be designed sensitively to avoid illuminating adjacent habitats Creation and reinstatement of woodland, scrub, grassland, hedgerow and ponds would provide replacement and alternative foraging areas in the long-term. Embedded design including widespan bridge would allow bats to commute along Weald Brook into the retained habitat within the loop road.	Unlikely to have a significant effect on conservation status of bat populations.	Slight adverse becoming neutral on establishment of habitats
		Operation Displacement due to lighting.	Permanent	LEMP to manage reinstated and created habitat in the long-term. Operational lighting will designed in accordance with best practice guidelines taking	Unlikely to have a significant effect on conservation status of bat populations.	Neutral

Biodiversity resource	Value	Summary of potential impacts	Impact characterisation	Summary of proposed mitigation/ compensation	Residual effect	Significance
				into consideration the presence of commuting and foraging bats and other wildlife, including measure to avoid and minimise light spill onto adjacent habitat, particularly woodland and the Weald Brook.		
Otter	County or Unitary Authority Area	Construction Loss of habitat and fragmentation of territories. Disturbance of individuals.	Temporary and permanent	New meanders and reprofiling of the rivers and flood-plain will be created. Safe mammal passage through culverts will be included through length of extended and existing culverts. Mitigation for pollution and disturbance in the CEMP.	Significant adverse effect on the conservation status of this species until new river habitats become established.	Moderate adverse becoming neutral on establishment of river habitat.
		Operation Killing or injury of individuals on roads.	Permanent	Safe mammal passage and fencing will reduce casualties on roads.	Unlikely to have a significant effect on conservation status of the otter population.	Neutral
Badger	Local	Construction Loss of foraging habitat. Disturbance to individuals or setts	Permanent and temporary	Habitat replacement, compensation and enhancement will replace foraging habitats. Wide-span overbridges allow movement of badgers. Mitigation in the CEMP will ensure that badgers are not harmed and setts not disturbed or damaged.	Unlikely to have a significant effect on conservation status of badger populations.	Neutral
		Operation	Permanent	Widespan bridges and safe mammal passage through	Unlikely to have a significant effect on	Neutral

Biodiversity resource	Value	Summary of potential impacts	Impact characterisation	Summary of proposed mitigation/ compensation	Residual effect	Significance
		Incidental killing or injury of individuals on roads.		culvert to allow movement of badgers.	conservation status of badger populations.	
Other priority mammals – hedgehog and harvest mouse	Local	Construction Loss of habitat. Harm to individuals Disturbance and displacement	Permanent and temporary	Habitat replacement and creation will benefit other mammal species and wide-span overbridges allow movement of mammals.	Unlikely to have a significant effect on conservation status of other priority mammal populations.	Neutral
		Operation Incidental killing or injury on roads.	Permanent	Incidental only.	Unlikely to have a significantly effect on conservation status of other mammal populations.	Neutral
Non-native invasive species	N/A	Construction Spreading of invasive species within Ingrebourne Valley SMI and other areas outside the Scheme. Spread of non-native species in habitat reinstatement and creation areas if untreated topsoil used.	Permanent	Measures to prevent the spread of non-native species including Himalayan balsam and non-native goldenrod will be implemented under a management plan.	Not significant.	Neutral
		Operation Negligible impacts	N/A	Management measures to be included in LEMP.	Not significant.	Neutral

7.11 Cumulative effects

7.11.1 Full details of the cumulative effects assessment are provided in Chapter 15 of the ES. A total of 19 'other developments' were identified which had the potential to impact upon environmental receptors in conjunction with the Scheme during construction. These developments were identified by consideration of their scale, proximity to the Scheme and overlap in construction period. Of these 19 other developments, three were identified as having potential cumulative effects relating to biodiversity. These include Lower Thames Crossing NSIP (LTC), potential large, medium or small wind energy development sites (identified in The London Borough of Havering Local Plan Proposals Map) and Land at Oak Farm, south of Colchester Road. These are set out in Table 7.22 below. Cumulative effects during operation are not anticipated.

Table 7.22: Potential cumulative effects with 'other developments' during construction

Development	Cumulative effect
Lower Thames Crossing	**Slight Adverse to Neutral** Lower Thames Crossing is a large scheme that affect similar habitats to the Scheme. The proposed new motorway is close to the Scheme and will affect similar habitats so there is potential for cumulative impacts during construction. However, the Lower Thames Crossing works proposed close to the Scheme may include mitigation / replacement land only. Lower Thames Crossing require full ecological assessment and mitigation and compensation strategy to be developed prior to DCO application. If advance ecological compensation measures are not undertaken there could be a cumulative loss of biodiversity in the local area until compensation sites fully establish.
Small, medium, large wind development sites	**Moderate Adverse to Slight Adverse** (depending on details of development) Construction of a wind energy development within the DCO boundary has the potential for cumulative impacts in combination during construction with the Scheme on Ingrebourne Valley SMI and great crested newts, as well as bats. Potential impacts could be through loss and damage of habitats, loss of potential bat roosting and foraging habitat and killing or injury of great crested newts by construction machinery. Construction of a wind energy development within the DCO boundary would also limit the potential mitigation options for the Scheme due to cumulative habitat loss. If construction of the Scheme and wind development were to take place at the same time Moderate adverse impact on the Ingrebourne Valley SMI and great crested newts and Slight adverse on bats are possible, although these impacts could be reduced by appropriate mitigation or compensation measures.
Land at Oak Farm, Maylands Fields	**Slight Adverse** Land at Oak Farm is separated from the main area of construction works by the A12 although a pipeline diversion may be undertaken in proximity to Land at Oak Farm as part of the Scheme. Both developments directly impact the Ingrebourne Valley SMI. The Land at Oak Farm proposal is

Development	Cumulative effect
	approximately 10 ha in size and long-term management is proposed to off-set habitat losses. Whilst great crested newt surveys undertaken for the Scheme have confirmed the presence of great crested newts in a pond a short distance from the Land at Oak Farm, an ecological assessment for this development considered the Ingrebourne River to be a significant barrier to dispersal and concluded the species did not use the habitat within Land at Oak Farm. Both projects will result in permanent habitat loss from the SMI and therefore there will be cumulative impacts. Taking into account the size of permanent loss (compared to the size of the SMI) and the proposed mitigation and compensation measures, the cumulative effect on Ingrebourne Valley remains as Slight Adverse in the long term and not significant.

7.11.2 Overall there are likely to be cumulative effects during construction in relation biodiversity impacts due to disturbance and loss of SMI land and disturbance to species.

7.12 NPS NN Compliance

7.12.1 The assessment for this Scheme has considered potential impacts set out in the Biodiversity and Ecological Conservation section (paragraphs 5.20 - 5.38) of the National Policy Statement for National Networks (NPS NN), as summarised below.

7.12.2 This report provides a preliminary assessment of the significance of effects of the Scheme on nature conservation resources (i.e. internationally, nationally and locally designated sites of nature conservation importance, legally protected species, priority habitats and other priority species identified as being of principle importance for the conservation of biodiversity.

7.12.3 It is considered that the potential mitigation and compensation options being proposed for this Scheme demonstrate a strong effort to take opportunities to conserve and advance biodiversity. This is in line with the Government's biodiversity strategy, as set out in Biodiversity Strategy 2020: A Strategy for England's Wildlife and Ecosystem Services.

7.12.4 In addition, it is considered that the potential mitigation and compensation options being proposed for this Scheme comply with the bullet points listed in paragraph 5.36 of the NPS:

- "During construction, they will seek to ensure that activities will be confined to the minimum areas required for the works.
- During construction and operation, best practice will be followed to ensure that risk of disturbance or damage to species or habitats is minimised (including as a consequence of transport access arrangements).
- Habitats will, where practicable, be restored after construction works have finished.
- Developments will be designed and landscaped to provide green corridors and minimise habitat fragmentation where reasonable.

- Opportunities will be taken to enhance existing habitats and, where practicable, to create new habitats of value within the Scheme landscaping proposals, for example through techniques such as the 'greening' of existing network crossing points and the habitat improvement of the network verge."

7.12.5 In accordance with the NPS (paragraph 5.32), loss of Ancient Woodland has been avoided, and loss of veteran trees has been minimised to the unavoidable loss of two veteran trees.

7.13 Monitoring

7.13.1 In order to ensure the appropriate establishment and long-term management of new habitats provided as mitigation, compensation or enhancements, the final Landscape and Ecology Management and Monitoring Plan (LEMP) will include details of monitoring measures required post-construction.

7.13.2 Monitoring for great crested newts would be carried out in accordance with the EPS mitigation licence, which would be agreed prior to commencement of construction.

7.13.1 Construction and operation of the Scheme will change the habitat availability in terms of foraging opportunities for bats. To monitor the success of habitat reinstatement and creation on foraging bats, a monitoring strategy will be developed including, pre-construction, during construction and post construction surveys. These surveys will cover Weald Brook (and what will be ECA A), woodland edges (The Grove and Alder Wood) and ECA B. Post construction surveys will cease when it has been established that the mix of species and abundance of bats using these habitats is similar to that in the pre-construction survey.

7.13.2 If an EPS licence for bats is required (due to loss or disturbance to bat roosts), monitoring requirements as set out in the EPS licence will be included in the final LEMP.

Should pre-construction survey work, or survey work carried out during the construction period determine that monitoring is required for other species (e.g. otter), these requirements will be set out in the final LEMP.

7.14 Summary

7.14.1 The potential ecological impacts of the Scheme have been assessed following appropriate methodologies. Impacts to designated sites, habitats and species within the study areas have been characterised and significant residual effects have been identified.

7.14.2 The Scheme design and associated development would result in the loss of approximately 35 ha of land, of which 5.2 ha would be permanent, including land from Ingrebourne Valley SMI.

7.14.3 In the short-term during construction of the Scheme, there would be temporary adverse effects on a number of biodiversity features including Ingrebourne Valley SMI, Ingrebourne River, Weald Brook and protected species such as great crested newts and otter.

7.14.4 Measures have been incorporated into the Scheme design to avoid and reduce effects including appropriate reinstatement of habitats within temporary construction areas, remodelling and enhancement of Ingrebourne River and

Weald Brook, creation and long-term management of woodland, grassland and scrub habitats and specific features for species such as new ponds for great crested newt.

7.14.5 There would be a residual adverse effect of moderate significance in relation to the unavoidable loss of two veteran trees.

7.14.6 Despite the proposed long-term management of land within Ingrebourne Valley SMI, there is the potential for a residual adverse effect of slight significance to Ingrebourne Valley SMI due to the proposed permanent loss of approximately 5.2 ha (2%) of land within the SMI boundary.

7.14.7 Despite the mitigation and enhancement package associated with the Ingrebourne River (realignment, backwaters and floodplain measures), the residual effect of the permanent loss of open water and riparian habitat caused by the 80 m culvert extension results in a residual adverse effect of moderate significance within the DCO boundary. The concomitant increase in habitat fragmentation caused by the culvert extension and new Grove bridge loop road crossing are assessed as having a long-term adverse effect on the watercourse habitat and habitat availability for aquatic species within the DCO boundary. Measures to off-set this residual effect with enhancement of riverine habitats elsewhere within the Ingrebourne WFD waterbody would be delivered by the Environment Agency and funded by the Applicant. Whilst this would lead to a neutral effect on the Ingrebourne WFD waterbody, there remains a residual effect on the Ingrebourne River within the DCO boundary.

7.14.8 It is considered that the mitigation and compensation proposals that have been described in this chapter have taken into consideration the requirements of the NPS, by enhancing existing habitats, creating new habitats and minimising habitat fragmentation.

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