national highways

Lower Thames Crossing

6.1 Environmental Statement Chapter 8 – Terrestrial Biodiversity (Clean version)

APFP Regulation 5(2)(a) & 5(2)(l)

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

Volume 6

DATE: December 2023
DEADLINE: 9

Planning Inspectorate Scheme Ref: TR010032
Application Document Ref: TR010032/APP/6.1

VERSION: 2.0

Revision History

Version	Date	Submitted at
1.0	31 October 2022	DCO Application
9.0	11 December 2023	Deadline 9

Lower Thames Crossing

6.1 Environmental Statement
Chapter 8 – Terrestrial Biodiversity
(Clean version)

List of contents

Page number

List of tables

Page number

8 Terrestrial biodiversity

8.1 Introduction

8.1.1 This chapter presents the assessment of the likely significant effects of the A122 Lower Thames Crossing (the Project) on terrestrial biodiversity during construction and operation. The assessment considers sites such as Sites of Special Scientific Interest (SSSI), habitats such as woodland and grassland, protected species such as bats and badgers, as well as a range of invertebrates, fish, amphibians, birds and other species. Marine habitats and species are considered separately in Chapter 9: Marine Biodiversity.

8.1.2 The assessment follows the methodology set out in the Design Manual for Roads and Bridges (DMRB) LA 108 Biodiversity (Highways England, 2020a) and relevant guidance including Chartered Institute of Ecology and Environmental Management (CIEEM) publications. This chapter also has due regard for the methods of assessing the impact of changes in air quality on designated and non-designated sites as set out in DMRB LA 105 Air Quality (Highways England, 2020b).

8.1.3 This chapter is supported by Figures 8.1 to 8.33 (Application Document 6.2), and additional information contained in the following appendices (Application Document 6.3):

a. Appendix 8.1: Designated Sites

b. Appendix 8.2: Plants and Habitats

c. Appendix 8.3: Terrestrial Invertebrates

d. Appendix 8.4: Freshwater Ecology

e. Appendix 8.5: Amphibians

f. Appendix 8.6: Reptiles

g. Appendix 8.7: Ornithology

h. Appendix 8.8: Bats

i. Appendix 8.9: Dormouse

j. Appendix 8.10: Water Vole

k. Appendix 8.11: Otter

l. Appendix 8.12: Badger (Confidential)

m. Appendix 8.13: Other Mammals

n. Appendix 8.14: Designated Sites Air Quality Assessment

o. Appendix 8.15: Construction and Operational Light Spill Calculations

p. Appendix 8.16: Draft EPS mitigation licence application – bats

q. Appendix 8.17: Draft EPS mitigation licence application – great crested newts

r. Appendix 8.18: Draft EPS mitigation licence application – dormouse

s. Appendix 8.19: Draft badger development licence application (confidential)

t. Appendix 8.20: Draft water vole conservation licence application

u. Appendix 8.21: Biodiversity Metric Calculations

v. Appendix 8.22: Terrestrial Ecology Surveys at Nitrogen Deposition Compensation Sites

w. Appendix 8.23: Terrestrial Biodiversity Legislation and Policy

8.1.4 A separate Habitats Regulations Assessment (HRA) – Screening Report and Statement to Inform an Appropriate Assessment (Application Document 6.5) has been undertaken following DMRB LA 115 Habitats Regulations assessment (Highways England, 2020f), and accompanies the Development Consent Order (DCO) submission, the findings of which are referred to in this chapter.

8.2 Legislative and policy framework

8.2.1 This assessment has been undertaken in accordance with relevant legislation and having regard to national and local plans and policies.

8.2.2 Appendix 8.23: Terrestrial Biodiversity Legislation and Policy (Application Document 6.3) sets out how the Applicant has considered and addressed those policies in the NPSs which relate to the assessment of effects considered in this chapter of the Environmental Statement. Policies in the NPSs which relate to decision making in relation to matters of relevance to this topic of the ES are addressed in the Planning Statement (Application Document 7.2).

Legislative requirements

8.2.3 Relevant wildlife legislation that has been considered during the assessment is presented in Appendix 8.23: Terrestrial Biodiversity Legislation and Policy (Application Document 6.3).

National policy framework

8.2.4 Nationally Significant Infrastructure Projects (NSIPs) are determined in accordance with the decision-making framework in the Planning Act 2008 (as amended) and relevant National Policy Statements (NPSs), as well as any other matters that are both important and relevant (which may include the National Planning Policy Framework (NPPF)) (Ministry of Housing, Communities and Local Government, 2021).

8.2.5 The National Policy Statement for National Networks (NPSNN) (Department for Transport, 2014) sets out the Government's policies to deliver NSIPs on the national road and rail networks in England. Modifications to the nationally significant energy infrastructure are required as part of the Project. Four utilities diversions constitute NSIPs in their own right, and therefore the Project will also be assessed against the following energy policy statements:

a. Overarching National Policy Statement for Energy (EN-1) (Department of Energy and Climate Change, 2011a)

b. National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (Department of Energy and Climate Change, 2011b)

c. National Policy Statement for Electricity Network Infrastructure (EN-5) (Department of Energy and Climate Change, 2011c).

8.2.6 However, the NPSNN forms the 'case-making' basis for the Project, and the need for nationally significant utilities diversions arises solely from the need for the road element of the Project.

8.2.7 National Highways has taken these policy requirements into account during the development and design of the Project and the preparation of this Environmental Statement (ES).

8.2.8 The NPPF, sets out the Government's planning policies. It provides a framework within which locally prepared plans for housing and other development can be produced.

8.2.9 The NPPF does not contain specific policies for NSIPs. However, the NPPF advises that local authorities' planning policies should take into account NSIPs which are located within their local areas. Paragraph 1.17 of the NPSNN states that the NPS and NPPF are consistent, and paragraph 1.18 explains that the NPPF is an important and relevant consideration, '*but only to the extent relevant to* [the] *project*'. Appendix 8.23: Terrestrial Biodiversity Legislation and Policy (Application Document 6.3) lists the planning policies at a national level and the Project response.

8.2.10 Further information on how the application has responded to national planning policies is available in the Planning Statement (Application Document 7.2).

Local policy framework

8.2.11 Consideration has been given to county policies within Kent, Essex, the Updated London Plan and local policies relating to terrestrial biodiversity within the following local authorities within the study area: Maidstone, Tonbridge and Malling, Gravesham, Thurrock, Havering, and Brentwood. These are outlined in Appendix 8.23: Terrestrial Biodiversity Legislation and Policy (Application Document 6.3) and are considered further within the Planning Statement (Application Document 7.2).

8.3 Assessment methodology

Standards and guidance

8.3.1 The following standards and guidance documents have been used in devising the methodology for data collection and assessment of terrestrial biodiversity impacts:

a. DMRB LA 108: Biodiversity (Highways England, 2020a)

b. DMRB LA 105: Air Quality standards (Highways England, 2020b)

c. DMRB LA 111: Noise and Vibration (Highways England, 2020c)

d. DMRB LA 113: Road Drainage and the Water Environment (Highways England, 2020d)

e. DMRB LD 118: Biodiversity Design (Highways England, 2020e)

f. Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal (CIEEM, 2018) (hereafter referred to as the 'CIEEM guidelines')

8.3.2 The value of ecological features such as sites, habitats and species, is determined with reference to characteristics such as legal status, conservation priority, habitat diversity and connectivity, population size, rarity, life cycle stage and distribution. Receptor values are framed within a geographical scale. This is outlined further in Table 8.5.

8.3.3 Likely significant effects have been characterised and described using the approach set out in the CIEEM guidelines and DMRB LA 108: Biodiversity (Highways England, 2020a) and LA 105: Air Quality standards (Highways England, 2020b).

8.3.4 If significant adverse effects are considered likely, the assessment has identified mitigation measures to avoid or reduce the significant adverse effect. These mitigation measures have been designed iteratively during an integrated design process working with Project engineers to arrive at a Project design which incorporates embedded mitigation, essential mitigation and enhancements. If after implementation of mitigation measures, a significant residual effect remains likely, then compensation measures have been investigated where appropriate (refer to Section 8.5).

8.3.5 Separately, and in response to paragraph 5.23 of the NPSNN, which states 'The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests', biodiversity metric calculations have been made to assess the biodiversity unit value of the baseline conditions, and that forecast to be generated by the Project. The assessment uses the Biodiversity Metric 3.1 Calculation Tool to determine whether the Project could result in a net gain in biodiversity units; full details of the methodology and calculations are provided in Appendix 8.21: Biodiversity Metric Calculations (Application Document 6.3).

Scope of the assessment

8.3.6 The scope of the terrestrial biodiversity assessment includes data collection from site surveys and existing data sources, so that a terrestrial biodiversity baseline can be established.

8.3.7 All aspects of terrestrial biodiversity have been considered as part of the assessment of likely effects as a result of the Project (excluding known range restricted species, such as red squirrel *Sciurus vulgaris*). This is outlined further in the Scoping Report for the Project (Highways England, 2017), which was issued to the Planning Inspectorate on 2 November 2017 and as agreed in the Scoping Opinion (see Appendix 4.1: The Inspectorate's Scoping Opinion and National Highways Response (Application Document 6.3)).

8.3.8 Other chapters of the ES have been referenced during the assessment of likely effects of the Project on terrestrial biodiversity, including: Chapter 5: Air Quality, Chapter 7: Landscape and Visual, Chapter 12: Noise and Vibration, Chapter 13: Population and Human Health, and Chapter 14: Road Drainage and the Water Environment.

8.3.9 A separate Habitats Regulations Assessment has also been undertaken to assess the impacts on European Sites (Application Document 6.5). This is in accordance with the Conservation of Habitats and Species Regulations 2017 (as amended by the EU Exit Regulations 2019).

Temporal Scope

8.3.10 The response of ecological receptors to potential impacts can vary temporally. For example, short-term temporal impacts on receptors with relatively short life cycles can result in much greater impacts than on receptors with longer life cycles. As a result, the temporal characteristics of potential impacts has been considered on a receptor-by-receptor basis in the assessment.

Limits of deviation and Rochdale Envelope

8.3.11 The Project's application of the Rochdale Envelope is summarised in Chapter 2: Project Description. The limits of deviation (LOD) for the project (defined in the draft DCO (Application Document 3.1)) represent an 'envelope' within which the Project would be constructed and have informed the reasonable worst case approach to assessment for the purposes of this chapter.

8.3.12 The topic-based assessments, which have been used to inform the assessments in this Chapter, consider the Limits of Deviation. The assessments presented in this Chapter, which are informed by other topic-based assessment, have therefore incorporated a consideration of the LoD.

Use of the river

8.3.13 Vessel movements on the River Thames are not relevant to this assessment. This is because the predicted change in vessel movements, as outlined in Chapter 2: Project Description ranges from two to 21 vessels per quarter. This is less than 2% of the annual average number of vessel movements associated with the Port of Tilbury. This difference in background levels of vessel movements is considered to result in no change with respect to disturbance to species using the river and adjacent habitats. Use of the river is

therefore excluded from the scope of this chapter. Assessment is included within Chapter 9: Marine Biodiversity (Application Document 6.1).

Scoping Opinion

8.3.14 A Scoping Report (Highways England, 2017) was issued to the Planning Inspectorate on 2 November 2017, setting out the proposed approach to this Environmental Impact Assessment (EIA). A Scoping Opinion was received from the Secretary of State on 13 December 2017, which included comments on the scope of assessment from the Planning Inspectorate and statutory environmental bodies. These comments have been taken into account in the preparation of this chapter, and the Project response is set out in Appendix 4.1: The Inspectorate's Scoping Opinion and National Highways Response (Application Document 6.3).

Consultation

Project consultation

8.3.15 Statutory Consultation under section 42 of the Planning Act 2008 was undertaken on the Project from 10 October 2018 to 20 December 2018. This provided an opportunity for consultees to comment on the Preliminary Environmental Information Report (PEIR) (Highways England, 2018). A summary of the responses can be found in the Consultation Report (Application Document 5.1). Consultees comprised statutory bodies, local authorities, people with an interest in land affected by the Project, and local communities.

8.3.16 The Project design continued to be developed, which resulted in changes in the project. These formed the basis for the Supplementary Consultation, which was undertaken from 29 January 2020 to 2 April 2020. Design Refinement Consultation was then undertaken from 14 July 2020 to 12 August 2020.

8.3.17 A Community Impacts Consultation was undertaken from 14 July 2021 to 8 September 2021. This sought feedback on the impacts of the Project at a local ward level, as well as the mitigation proposed for those impacts. Changes to the Project since the Design Refinement Consultation were also presented, along with a summary of how feedback to earlier consultation had shaped the development of the Project.

8.3.18 Prior to the submission of this DCO application, a Local Refinement Consultation was held between 12 May 2022 and 20 June 2022. This provided local communities with the opportunity to comment on proposed refinements to the Project.

8.3.19 These Consultations all included information about the environmental impacts associated with the refinements presented for consultation. A summary of the responses to these consultation stages can also be found in the Consultation Report (Application Document 5.1).

Stakeholder engagement

8.3.20 A summary of the stakeholder engagement specific to terrestrial biodiversity during the EIA process is provided in Table 8.1.

Table 8.1 Stakeholder engagement

Stakeholder	Date of meeting/ communication	Summary of discussions
Environment Agency (EA)	Various 2015–2022	Discussions of Project design, including route options, levels of assessment, methodology (both survey and assessment), survey results, covering impacts on receptors (particularly designated sites), culvert impacts on water voles, mitigation and compensation for the Project.
Natural England	Various 2015–2022	Discussions of the design of the Project, from route options through to detailed designs, levels of assessment, methodology (both survey and assessment), survey results, covering impacts on receptors, mitigation and compensation for the Project. Discussions of the licensing approach for protected species and submission of draft licences for review. Discussions around potential impacts to and mitigation for terrestrial invertebrates, including Natural England's consideration of SSSI designation around the Thames Estuary.
Kent County Council	Various 2018–2022	Discussion around Project design, the NPSNN, likely impacts to AONB, survey results, mitigation and compensation.
Essex County Council	Various 2018–2019	Discussion around Project design, survey results, mitigation and compensation design.
Gravesham Borough Council	Various 2021	Discussion around Project design, survey results, mitigation and compensation design.
Thurrock Council	Various 2016–2022	Discussion of options for net gain for invertebrates, material reuse, impacts to Local Wildlife Sites (LWS), discussion of preliminary environmental impacts and mitigation and discussion of baseline for Goshems Farm LWS.
London Borough of Havering	Various 2019–2022	Discussion around Project design, survey results, mitigation and compensation design.
Brett Aggregates	September 2018	Discussion to inform green infrastructure study and the Project's mitigation proposals.
Buglife	Various 2018–2022	Discussion of the approach to environmental assessment, design of the Project, survey results and mitigation and compensation creation. Detailed discussion of mitigation proposals for terrestrial invertebrates.
Bumblebee Conservation Trust	Various 2020–2021	Site walkover and discussion of potential mitigation options, notably for shrill carder bee *Bombus sylvarum*.
Campaign to Protect Rural England Kent	September 2016	To update the Campaign to Protect Rural Kent on the Project post-consultation and Project next steps and discuss response to the public consultation.

Stakeholder	Date of meeting/ communication	Summary of discussions
Enovert	Various 2018–2021	Discussion to inform green infrastructure study and the Project's mitigation proposals, and the partnership over mitigation provision, particularly reptile translocation.
Essex Wildlife Trust (EWT)	Various 2018–2022	Discussion of biodiversity no net loss, no net deforestation, green infrastructure opportunities, potential legacy opportunities, integration of woodland into the Project, opportunities of new community woodland in conjunction with the Forestry Commission, discussion of partnership to provide ecological mitigation, particularly for the translocation of water voles *Arvicola amphibius* in support of the Waterlife Recovery East project, and barn owl *Tyto alba* nesting sites on EWT reserves.
Forestry England (formerly the Forestry Commission)	Various 2018–2022	Discussion of proposed mitigation; likely impacts to Areas of Outstanding Natural Beauty (AONBs) and the NPSNN; green infrastructure; walking, cycling and horse riding (WCH) provision; landscape design; ecology baseline; and approach to compensating. Notable discussions around provision of compensatory woodland planting in Kent.
Kent Downs AONB	Various 2016–2019	Discussion of post-consultation responses, green infrastructure opportunities, the Project's mitigation proposals, landscape surveys, compensation options for the AONB and collaboration options outside the Order Limits.
Kent Wildlife Trust	September 2018–September 2019	Discussion of green infrastructure, WCH provision, landscape design, Project update, and ecology baseline and mitigation.
Land of the Fanns Partnership	November 2018	Discussion of options for reuse and transportation of material.
RSPB	Various 2019–2022	Discussion of potential for material reuse; green infrastructure; WCH provision; landscape design; Project update and ecology baseline and mitigation/ enhancements; and scope of works and legal agreements.
Rural Arisings	Various 2018–2022	Discussion to inform green infrastructure study and the Project's mitigation proposals including translocation of species.
Thames Chase Trust	Various 2016–2019	To discuss updates on the Project post-consultation, green infrastructure study, mitigation proposals and compensation creation.
Thames and Medway Canal Association	August 2018	Pre-statutory consultation engagement meeting regarding the Project and approach to environmental survey and assessment with reference to ancient woodland.
Woodland Trust	Various 2018–2022	To discuss green infrastructure, WCH provision, landscape design, Project update and ecology baseline, mitigation and impacts, particularly to protected species

Stakeholder	Date of meeting/ communication	Summary of discussions
		and potential collaborative working over enhancements to Ashenbank Wood for dormice, and compensating approach to ancient woodland impacts.

Study area

8.3.21 The study area was defined to encompass the Project's Zone of Influence (ZoI), within which terrestrial biodiversity features could potentially be affected by the construction and/or operational phases of the Project. It encompasses the Order Limits for the Project, including any offsite ancillary works or areas, construction compounds, haul routes, borrow pits and areas of temporary land-take.

8.3.22 The study area varied depending on the terrestrial biodiversity feature being assessed and the nature of the likely direct and indirect impacts. Statutory designated sites including Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Ramsar sites, SSSIs and National Nature Reserves (NNRs) were assessed up to 2km from the Order Limits, with an expanded study area for European Sites designated for bats within a 30km radius, in recognition of the considerable distances that some species of bats will range between roost sites. Non-statutory designated sites up to 500m from the Order Limits were assessed. An exception has been made where there is a likely direct hydrological link between a non-statutory site and the Order Limits, in which case the ZoI was extended to 2km both upstream and downstream.

8.3.23 In line with DMRB LA 105 Air Quality (Highways England, 2020b), the study areas for statutory and non-statutory designated sites were further extended to encompass the area within 200m of the Affected Road Network (ARN), where air quality effects could arise from forecast changes in traffic flow as a result of the Project. Further detail is provided in Chapter 5: Air Quality. This extension in the study area is only associated with the assessment of air quality effects.

8.3.24 The study area for habitats and species was determined on an individual basis, based on their sensitivity to environmental change. The study areas for individual biodiversity features are outlined in Table 8.3, and further discussed in the associated technical appendices (Application Document 6.3, Appendices 8.1 to 8.23).

8.3.25 For terrestrial biodiversity, the study area includes everything above the mean high-water springs; for anything below this line please refer to Chapter 9: Marine Biodiversity. The exception to this is intertidal birds, as these were found foraging both above and below this line. As such, these are considered within this chapter.

Impact assessment methodology

8.3.26 The assessment follows the general approach described in Chapter 4: EIA Methodology. This chapter provides topic-specific information regarding the methodology used for establishing the baseline conditions, and the methods used for the construction and operational phase assessments.

Method of establishing baseline conditions

Existing baseline

8.3.27 The existing baseline in relation to terrestrial biodiversity was established through a combination of desk-based studies and field surveys.

8.3.28 The following sections outline the approaches taken, with further details provided in the technical appendices for the individual ecological features (Application Document 6.3, Appendices 8.1 to 8.14, and 8.22).

Desk-based studies

8.3.29 A desk-based review of the data sources outlined in Table 8.2 has been undertaken to determine the baseline conditions across the Project study area. Information on sites, habitats and species were obtained. The emphasis of individual species records was placed on records that were 10 years old or less, from the date of the initial desk study (which was 2017), with updated desk study data collected in 2022. Where the ARN extended beyond the study areas identified above, only records of designated and non-designated sites were obtained. These are highlighted in Table 8.2 below.

Table 8.2 Terrestrial desk-study data sources

Data source	Information requested	Data format
Department for Environment, Food and Rural Affairs (Defra) Multi-Agency Geographic Information for the Countryside (MAGIC) website (Natural England, n.d.)	Data pertaining to statutory designated sites, including sites within the ZoI for the ARN.	Online only
Kent and Medway Biological Records Centre (KMBRC, 2022) Essex Wildlife Trust Biological Records Centre (EWTBRC, 2020) and Essex Field Club (EFC, 2022) Greenspace Information for Greater London (GiGL, 2022)	Data on local (county) wildlife sites, Sites of Importance for Nature Conservation (SINC), legally protected and otherwise notable species, including non-designated sites within the ZoI for the ARN.	GIS and excel spreadsheets
Local Biodiversity Action Plans (BAP) Essex Biodiversity Project (2011), Kent Biodiversity Partnership (2009) and Biodiversity Audits (e.g. The Thames Estuary Partnership Habitat Action Plan and Thurrock Council Biodiversity Audit)	Reviewed to identify habitats and species of local importance, including LWSs and Local Nature Reserves (LNRs).	Factual reports
Data was collated for UK BAP priority habitats using the MAGIC website (Natural England, n.d.).	Priority habitats listed in accordance with the requirements of section 41 of the Natural Environment and Rural Communities (NERC) Act 2006.	Online only
Thames Terrace Invertebrates: A Masterplan for Landscape-scale Conservation in the Greater Thames	Information on habitats of importance to invertebrate species located within the Thames Estuary.	Factual reports

Data source	Information requested	Data format
Marshes (Essex County Council, Buglife, University of East London and Natural England, 2013) English Heritage (2014) Essex Grazing Marsh Project.		
Natural England's ancient woodland inventory (via the MAGIC website) and the Woodland Trust's ancient tree inventory.	Used to identify areas of ancient woodland and individual veteran and ancient trees respectively, within the Project survey area.	Online GIS
Natural England publications relating to Thames Estuary and Marshes SPA, and the Thames Estuary and Marshes Ramsar site including SPA and SAC Natura 2000 forms, Ramsar site Data Sheet. Natural England report 'What do we know about the birds and habitats of the North Kent Marshes?' (Liley, 2011).	Information relating to European designated sites, including the conservation objectives for the Thames Estuary and Marshes SPA, and the current condition status of the South Thames Estuary and Marshes SSSI (which is encompassed by the SPA and Ramsar site designations).	Factual reports
Map data from the RSPB	Identifies all RSPB reserves within the Thames Estuary area.	Factual reports

Fieldwork

8.3.30 Field surveys were undertaken to compile a terrestrial biodiversity baseline for the Project, with the methodologies used following good practice guidance. A summary of the field survey methodologies and study areas is given in Table 8.3 below. For full details of survey methodologies please refer to the terrestrial biodiversity appendices (Application Document 6.3, Appendices 8.1 to 8.14).

Table 8.3 Terrestrial survey work undertaken

Survey activity	Survey extent	Description of survey activity
Extended Phase 1 habitat survey	Within and up to 50m from the Order Limits	Survey to identify habitat features, protected and notable plants, survey hedgerows, identify Invasive Non-Native Species (INNS) and features likely to be of value to species. These surveys were also used to plan additional species and botanical surveys. See Appendix 8.2 (Application Document 6.3).
National Vegetation Classification (NVC) surveys	Within the Order Limits	Surveys recording and classifying vegetation features to assess the importance of these features. See Appendix 8.2 (Application Document 6.3).
Lichen and bryophytes	Within and up to 200m from the Order Limits	Surveys identifying and recording lichen and bryophyte species. See Appendix 8.2 (Application Document 6.3).

Survey activity	Survey extent	Description of survey activity
Terrestrial invertebrates	Within and up to 200m from the Order Limits	Survey to identify terrestrial invertebrate species, classify assemblages and categorise their importance. See Appendix 8.3 (Application Document 6.3).
Freshwater fish, macrophytes and macro-invertebrates	Within, and up to 1km from, the Order Limits	Survey to identify aquatic species, classify assemblages and categorise their importance. See Appendix 8.4 (Application Document 6.3).
Great crested newt (GCN) *Triturus cristatus*	Within and up to 500m from the Order Limits	Habitat Suitability Index surveys to assess water bodies for the potential suitability of habitats to support GCN. eDNA water sampling and analysis to identify the presence/absence of GCN within water bodies during the breeding season. Population surveys to record the number of GCN within water bodies known to support them. See Appendix 8.5 (Application Document 6.3).
Reptiles	Within the Order Limits	Surveys to determine the presence and numbers of reptile species in areas of suitable habitat. See Appendix 8.6 (Application Document 6.3).
Ornithology (designated sites and functionally linked land transects)	Within and up to 1km from the Order Limits where sites designated for their bird interests are present.	Twice-monthly walked transects undertaken year-round within areas of habitat that could be used by birds associated with the Thames Estuary and Marshes Ramsar site (therefore described as being potentially functionally linked) to assess the importance of these areas for birds. Monthly transect surveys undertaken in woodland SSSIs where birds are a named feature. See Appendix 8.7 (Application Document 6.3).
Ornithology (main route transects)	Within, and up to, 200m from the Order Limits	Walked transect surveys to assess the breeding and wintering bird assemblage of the main route. See Appendix 8.7 (Application Document 6.3).
Ornithology (tidal vantage point surveys)	Within, and up to 1km from the Order Limits where it is adjacent to the River Thames.	Survey to assess the bird population of the River Thames and assess areas which are particularly important for foraging/roosting birds. See Appendix 8.7 (Application Document 6.3).
Barn owl *Tyto alba*	Within, and up to 1km, from the Order Limits	Survey to identify the location and density of barn owl nests. In addition, identification of key foraging habitat for barn owls. See Appendix 8.7 (Application Document 6.3).
Bats (buildings and tree inspections)	Within, and up to 50m (depending on locations of roosts) from the Order Limits.	Survey to identify roost locations and classify the importance of bat roost sites based on species present and number/type of roost site. See Appendix 8.8 (Application Document 6.3).

Survey activity	Survey extent	Description of survey activity
Bats (emergence and activity surveys)	Within, and up to 50m (depending on locations of roosts) from the Order Limits.	Survey to identify roost locations and classify the importance of bat roost sites based on species present and number/type of roost site. In addition, identification of key bat commuting routes, particularly in relation to where the Project could cause fragmentation of these commuting routes. See Appendix 8.8 (Application Document 6.3).
Dormouse *Muscardinus avellanarius*	Within and up to, 500m from the Order Limits	Survey to establish the presence/absence, and abundance of, dormouse. See Appendix 8.9 (Application Document 6.3).
Water vole *Arvicola amphibius*	Within and up to 500m from the Order Limits	Survey to establish the presence/absence, and abundance of, water voles. See Appendix 8.10 (Application Document 6.3).
Otter *Lutra lutra*	Within and up to 500m from the Order Limits	Survey to identify signs of otter presence within watercourses. See Appendix 8.11 (Application Document 6.3).
Badger *Meles meles*	Within and up to 500m from the Order Limits	Survey to identify setts and other signs of badger presence. See Appendix 8.12 (Application Document 6.3).
Other notable mammals including brown hare *Lepus europaeus*, harvest mouse *Micromys minutus* and hedgehog *Erinaceus europaeus*	Within and up to 500m from the Order Limits	Surveys to assess the presence/absence of mammals listed in accordance with the requirements of section 41 of the NERC Act 2006. See Appendix 8.13 (Application Document 6.3).

8.3.31 The DCO application documents identify the locations of habitat creation sites proposed as compensation for the effects of nitrogen deposition. The works within these areas is habitat creation, converting the existing agricultural habitat into semi-natural habitat as part of the compensation strategy for the potential increase in nitrogen deposition from the construction and operation of the Project (see Figure 2.4: Environmental Masterplan (Application Document 6.2)). It is proposed to retain existing semi-natural habitat within these sites (Design Principles (Application Document 7.5) Clause no. LSP.27), retaining their ecological value, increasing opportunity for natural regeneration of habitats, and reducing potential impacts to existing ecology within the sites and the wider landscape. Given the proposal for these sites, the scope of ecological survey undertaken at them was designed to be proportionate to the potential impact pathways. As such, the ecological receptors listed below have been scoped into the assessment of impacts from the Project as the work has the potential to directly affect supporting habitat. Other receptors covered above have been scoped out as it is not considered that there would be a pathway to a significant effect on them as a result of these habitat creation proposals, principally because the semi-natural habitat likely to support them, if present, would be retained. A summary of the field survey methodologies and study areas for these compensation sites is given in Table 8.4 below. For full details of survey methodologies please refer to the terrestrial biodiversity appendix (Application Document 6.3, Appendix 8.22).

Table 8.4 Terrestrial survey work undertaken – nitrogen deposition compensation sites

Survey activity	Survey extent	Description of survey activity
Habitats	Within and up to 50m from the Order Limits	UK Hab survey to classify habitats present within the survey extent. See Appendix 8.22 (Application Document 6.3).
Great crested newt	Within and up to 250m from the Order Limits	Habitat Suitability Index surveys to assess water bodies within 250m of the compensation areas boundaries for the potential suitability of habitats to support GCN. eDNA water sampling and analysis to identify the presence/absence of GCN within water bodies during the breeding season. See Appendix 8.22 (Application Document 6.3).
Badger	Within and up to 50m from the Order Limits	Survey to identify setts and other signs of badger presence within 50m of the compensation areas boundaries. See Appendix 8.22 (Application Document 6.3).

Future baseline ('Without Scheme' scenario)

8.3.32 To account for changes in the future baseline, a future 'do minimum' scenario is considered for the ES. This provides a forecast of what the future baseline conditions will be at the commencement of construction, accounting for all factors, but without the Project under consideration. To enable direct comparison between this and the 'post development' impact predictions made during the EIA, this future baseline will be set at the time of the commencement of construction (2024). It will further consider any additional changes in the future baseline at the opening year of the Project (2030) and throughout the operational phase.

8.3.33 The existing and future baseline conditions for terrestrial biodiversity are outlined in Section 8.4.

Method of assessment – construction

8.3.34 The construction of highways can affect application site-specific features (habitats or wild flora) and mobile features (populations of wildlife). Impacts can occur through several mechanisms. Potential impact pathways arising from the Project were identified and characterised to assess the likely changes to ecological features that could occur as a result of the Project. The level of likely change was then considered against the importance of each ecological feature to determine the significance of any effects. This subsequently determined the scale of any mitigation requirements.

8.3.35 Construction activities were assessed against the CIEEM guidance and DMRB standards as noted above.

8.3.36 The assessment of construction phase effects includes consideration of potential effects arising from the following:

a. Construction disturbance, air quality, lighting, vibration, noise or hydrological impacts

b. Loss of functionally linked land associated with designated sites

c. Direct loss of wildlife habitat through land-take

d. Severance, by dividing habitats or wildlife corridors

e. Direct mortality through construction activities

f. Disruption of local watercourses

g. Disturbance to sites, habitats and species resulting from increased visitor pressure and recreational activities

8.3.37 Outputs of transport modelling data has been used for this terrestrial biodiversity assessment to inform the assessment of effects on designated sites from changes in air quality as a result of the Project. Further information can be found in Chapter 5: Air Quality and Appendix 8.14 (Application Document 6.3) of this Chapter (Chapter 8) of the ES.

Method of assessment – operation

8.3.38 Operational phase activities were also assessed against the CIEEM guidance and DMRB standards as noted above.

8.3.39 The assessment of operational phase effects includes consideration of potential effects arising from the following:

a. Changes in air quality on designated sites

b. Disturbance or hydrological effects on designated sites, functionally linked land or qualifying features of designated sites

c. Direct mortality through traffic collisions

d. Polluted road runoff affecting the aquatic environment

e. Impacts from road lighting

f. Impacts on verge vegetation from polluted spray from the road

g. Noise disturbance

h. Disturbance to sites, habitats and species resulting from increased visitor pressure and recreational activities

8.3.40 Outputs of transport modelling data has been used for this terrestrial biodiversity assessment to inform the assessment of effects on designated sites from changes in air quality as a result of both the construction and operational phases of the Project. Further information can be found in Chapter 5: Air Quality, and Appendix 8.14 (Application Document 6.3) of this Chapter (Chapter 8) (Application Document 6.1).

Determining significance of effects

8.3.41 As described in Chapter 4: EIA Methodology, the significance of environmental effects was determined by taking into account the value (importance) of the receptor and the magnitude of the impact.

8.3.42 The following paragraphs set out the value (importance) and the level of impact magnitude criteria used in this assessment, following the approach detailed within DMRB LA 108 (Highways England, 2020a). Significance of effect was then determined using the matrix approach shown also detailed within DMRB LA108.

8.3.43 The assessment of significance undertaken in this chapter is used as the basis for identifying effects which are considered significant in the context of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the EIA Regulations).

Defining value/sensitivity of resources and/or receptors

8.3.44 The importance of ecological features present within the study area of the Project is assessed through consideration of attributes including rarity, legal status, population size, distribution and connectivity, and natural range. The CIEEM (2018) guidelines and DMRB LA 108 (Highways England, 2020a) standards provide a geographical frame of reference for determining the level of importance of ecological features. This approach is outlined in Table 3.9 in LA 108 and is presented in Table 8.5 below. Where appropriate, additional detail on biodiversity resources relevant to this assessment have been incorporated into the table, such as a geographical frame for reference associated with priority habitats, and the inclusion of Red List of Threatened Species, listed as being Near Threatened or Vulnerable.

Table 8.5 Biodiversity resource importance

Importance	Biodiversity resources
International (European)	Sites: • Sites of Community Importance • SPAs • Potential SPAs (pSPAs) • SACs • Candidate or possible SACs (cSACs or pSACs) • Wetlands of International Importance (Ramsar site) • Biogenetic Reserves, World Heritage Sites (where recognised specifically for their biodiversity value) and Biosphere Reserves

Importance	Biodiversity resources
	• Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such Species: Resident, or regularly occurring, populations of species which can be considered at an international or European level where any of the following apply: • The loss of these populations would adversely affect the conservation status or distribution of the species at an international or European scale. • The population forms a critical part of a wider population at this scale. • The species is at a critical phase of its life cycle at an international or European scale.
National (UK/England)	Sites: • SSSIs or Areas of Special Scientific Interest • NNRs • National Parks • Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such. Habitats: • Areas of UK BAP priority habitats and habitats included in the relevant statutory list of priority species and habitats where impacts on these habitats would adversely affect their conservation status at a UK or national scale. • Areas of irreplaceable habitats including: Ancient woodland Ancient or veteran trees Blanket bog Limestone pavement Sand dunes Salt marsh Lowland fen • Areas of habitat which meet the definition for habitats listed above but which are not themselves designated or listed as such. Species: Resident, or regularly occurring, populations of species which can be considered at a UK or national level where any of the following apply: • The loss of these populations would adversely affect the conservation status or distribution of the species at a UK or national scale. • The population forms a critical part of a wider population at this scale. • The species is at a critical phase of its life cycle at a UK or national scale. • The species is included in the national (Great Britain/England) Red List of Threatened Species (also known as 'Red Data Book' species), as identified by the International Union for Conservation of Nature (IUCN) as being Critically Endangered.
Regional (south-east England)	Sites: Designated sites (non-statutory) including heritage coasts Habitats:

Importance	Biodiversity resources
	Areas of UK BAP priority habitats and habitats included in the relevant statutory list of priority species and habitats where impacts on these habitats would adversely affect their conservation status at a regional scale; Areas of habitats identified (including for restoration) in regional plans or strategies (where applicable) Species including: Resident, or regularly occurring, populations of species which can be considered at a regional level where any of the following apply: • The loss of these populations would adversely affect the conservation status or distribution of the species at a regional scale. • The population forms a critical part of a wider regional population. • The species is at a critical phase of its life cycle. • The species is identified in regional plans or strategies. • The species is included in the national (Great Britain/England) Red List of Threatened Species (also known as 'Red Data Book' species) as being Endangered.
County or equivalent authority (Kent/Essex)	Sites: Wildlife/nature conservation sites designated at a county (or equivalent) level by a county or equivalent authority including: • LWS • Local Nature Conservation Sites • LNRs • Sites of Importance for Nature Conservation • Sites of Nature Conservation Importance • County Wildlife Sites Habitats: Areas of UK BAP priority habitats and habitats included in the relevant statutory list of priority species and habitats where impacts on these habitats would adversely affect their conservation status at a county scale. Areas of habitats identified in county or equivalent authority plans or strategies (where applicable), Species including: Resident, or regularly occurring populations of species which can be considered at a county level where any of the following apply: • The loss of these populations would adversely affect the conservation status or distribution of the species at a county or unitary authority scale. • The population forms a critical part of a wider county or equivalent authority area population, e.g. metapopulations. • The species is at a critical phase of its life cycle. • The species is identified in county or equivalent authority area plans or strategies. • The species is included in the national (Great Britain/England) Red List of Threatened Species (also known as 'Red Data Book' species) as being Near Threatened or Vulnerable.
Local	Sites:

Importance	Biodiversity resources
(cities, parishes or boroughs)	Wildlife/nature conservation sites designated at a local level by a city/parish/borough authority including: • LWS • Local Nature Conservation Sites • LNRs • Sites of Importance for Nature Conservation • Sites of Nature Conservation Importance • Sites of Local Nature Conservation Importance Habitats: Areas of habitat, species populations or communities considered to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange. Species: Populations/communities of species considered to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal or genetic exchange.

8.3.45 Professional judgement has been exercised in determining the importance of biodiversity resources, in accordance with the criteria outlined above in Table 8.5. Where a biodiversity resource falls into more than one category, the highest value category has been applied. Contextual information pertaining to the conservation status, rarity and diversity of habitats and species has been used to inform the valuation of biodiversity resources, where it exists. This is outlined further in Section 8.4, where relevant.

8.3.46 Features that are considered to be of local importance or greater for biodiversity, and which could be affected by the Project, have been considered in the assessment of likely significant effects. Likely significant effects would not be predicted on features that are of no appreciable importance. This includes areas of habitat, species populations or communities that are not considered to appreciably enrich the habitat resource within the local (or greater) context, including features of importance for migration, dispersal, or genetic exchange. Examples of such features include areas of built development, heavily modified habitats that support a low species diversity, populations of species that are common, widespread and unthreatened, and invasive non-native species.

Defining level of impact

8.3.47 The level of impacts on ecological features are reported in accordance with the criteria provided in Table 3.11 in DMRB LA 108 (Highways England, 2020a) and is reproduced in Table 8.6 below.

Table 8.6 Level of impact on biodiversity resources

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

Defining effect significance

8.3.49 Where an impact is identified, the importance of the ecological feature is used to help determine the scale at which the effect is significant. The significance of effects is determined according to the matrix presented in Table 8.7 (DMRB LA 108 (Highways England, 2020a)).

8.3.50 For the purpose of this assessment, the likely significant effects of the Project have been assessed in accordance with DMRB LA 108 (Highways England, 2020a), with reference also made to the CIEEM guidelines (2018).

8.3.51 The CIEEM guidelines define a significant effect as '*an effect that either supports or undermines biodiversity conservation objectives for "important ecological features" or for biodiversity in general*'.

8.3.52 Likely effects have been characterised and described using the following parameters:

a. Positive (beneficial) or negative (adverse)
b. Magnitude (size or amount of an effect)
c. Extent (the area over which the effect occurs)
d. Duration (the time the effect is expected to last prior to recovery or replacement of the resource or feature)
e. Complexity (direct, indirect or cumulative)
f. Reversibility (permanent or temporary)
g. Timing and frequency (some changes may only cause an impact if they coincide with critical life-stage or seasons (e.g. bird nesting season))

Table 8.7 Significance matrix

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

8.3.53 If significant adverse effects are considered likely, measures are proposed to mitigate these effects, which have included the re-application of Project design measures to avoid and reduce effects further, where possible. If, after the implementation of design and mitigation measures, a significant residual effect is anticipated, compensation measures are considered. In line with the methodology presented in DMRB LA 108: Biodiversity (Highways England, 2020a), significant effects typically comprise effects that remain within the moderate, large or very large categories once mitigation has been taken into account.

8.3.54 This assessment has considered the interrelationship of effects from the Project that could occur throughout more than one phase (e.g. construction and operation), and the potential for such effects to interact to create a greater effect on an ecological feature than if just assessed in isolation in each of these two key phases. It has also considered the interrelationship effects between different environmental topics. For example, planting proposed to mitigate for landscape and visual effects could inadvertently have an adverse effect on terrestrial/avian ecology, by encouraging animals to forage in close proximity to the highway where they might be at risk of collision with motor vehicles. This

assessment has drawn upon outputs of other topics to determine the nature and extent of such effects.

8.3.55 Cumulative effects that would result from the interaction of the Project and other developments have also been considered. This is addressed further in Section 8.7 and Chapter 16: Cumulative Effects Assessment.

Assumptions and limitations

8.3.56 General assumptions used throughout the ES, and limitations affecting the assessments are set out in Chapter 4: EIA Methodology. Relevant assumptions and any other limitations encountered during the Terrestrial Biodiversity assessment are as described below. Acknowledging the assumptions and limitations identified below and in Chapter 4: EIA Methodology, the ES is considered robust and in line with relevant legislation, policy and guidance.

8.3.57 This assessment has used the 'do minimum' method for forecasting the future baseline. This has taken into account the air quality and noise changes modelled as part of the respective chapters.

8.3.58 In the absence of the Project it is anticipated that farmland, hedgerows, woodlands, grassland and scrub would continue to be managed as they are currently. No significant change to watercourses or ponds is anticipated in the foreseeable future, although it is recognised that some ponds may disappear (as a result of drying or infilling) and others may be created during this time.

8.3.59 Non-statutory sites, including LWS, Local Nature Conservation Sites, LNRs, Sites of Importance for Nature Conservation and Sites of Nature Conservation Importance, have been valued as being of county-level importance, with the exception of those sites that support nationally important irreplaceable habitats such as ancient woodland.

8.3.60 The assessment of effects on terrestrial biodiversity is based on a number of considerations including desk-study data, stakeholder guidance and primary field survey data. The key limitations for the field surveys relate to land access requirements. Some locations within the study areas have not been surveyed due to land access restrictions and, in some cases, access was revoked during certain key periods in the year. In these situations, the assessment has been carried out in a precautionary manner and is based on reasonable worst-case scenarios, using desk-based information where it exists to inform professional judgement. Where survey gaps exist in relation to identifying and mapping habitats, high-resolution aerial photos have been used to determine the broad habitat types that are likely to be present. This is outlined further in Appendix 8.2 (Application Document 6.3). Further details regarding the limitations of the field surveys are stated in the individual technical reports in the Environmental Statement (Application Document 6.3, Appendices 8.1 to 8.14 and 8.21 to 8.22). None of those limitations is considered to materially affect the assessment of likely effects.

8.3.61 Due to access restrictions or inconclusive survey data, GCN presence/absence could not be determined at 36 ponds within the GCN survey boundary. A precautionary approach has been implemented in such instances, using professional judgement and existing survey data from third-party sources and nearby areas to inform any assumptions made with regard to likely presence or

absence of GCN from these ponds. In all cases, except where the habitat was deemed unsuitable, the presence of medium-sized populations of GCN has been assumed, which is an approach that has been agreed with Natural England (see Appendix 8.17: Draft EPS mitigation licence application – great crested newts with regard to GCN (Application Document 6.3)). Pre-construction surveys at all ponds, including these unsurveyed ponds, will be undertaken prior to works being carried out, where possible. Despite this, the Project provides sufficient landscaping and mitigation areas to compensate the loss of terrestrial habitat. Furthermore, the provisions of the draft GCN derogation licence (Appendix 8.17: Draft EPS mitigation licence application – great crested newts (Application Document 6.3)) would ensure favourable conservation for GCN is maintained.

8.3.62 Data provided by third parties such as biological records centres, frequently do not include negative survey data (data showing where surveys have occurred, and where species absence has been proven likely). Certain areas such as nature reserves have been well studied whereas other areas (for example, private farmland) have not. For this reason, the absence of desk-study records for a species has not been taken to indicate species absence.

8.3.63 During the three-year study period, there have been some extremes of weather including the ‘beast from the east’ storm system that brought widespread disruption during February 2018, and the period of heat and drought in July/August 2018. Although these weather systems have been aberrant and are beyond what could be reasonably expected over a five-year period, it is likely that with future climate change they will become more frequent, and therefore the conditions that were experienced during the baseline surveys may not necessarily be regarded as atypical of a future baseline at the year of opening.

8.3.64 Impacts associated with utilities diversions and other ancillary construction activities are included within the assessment of likely construction effects, with likely effects including habitat loss, fragmentation and disturbance. Likely significant effects associated with increased risk of bird-strike with overhead lines are not predicted, since the proposed works associated with the utilities infrastructure include the restringing or slight diversions of existing overhead line alignments and are therefore unlikely to pose a greater risk to birds than is already experienced as part of the existing baseline.

8.3.65 The construction modelling undertaken using the Project's transport model provides an extensive quantitative assessment of the forecast impact of construction works on the road network, using the same traffic baseline and forecasting work that informs the operational modelling.

8.3.66 The DCO application has been developed on the basis of a 2030 opening year. This assumes consent is granted in 2024. Following the DCO rant there would be preparatory works, referred to in the draft DCO as preliminary works taking place in 2024. The main construction period for the Lower Thames Crossing would start in early 2025, with the road being open for traffic in late 2030. Construction may take approximately six years, but as with all large projects there is a level of uncertainty over the construction programme, which will be refined once contractors are appointed and as the detailed design is developed. The 2030 opening year has been selected as the basis for the assessments and is representative of the reasonable worst case scenario. This has been

used consistently across the environmental assessments, transport assessments and the economic appraisal of the Project.

Nitrogen deposition compensation sites

8.3.67 The DCO application documents identify the locations of habitat creation sites proposed as compensation for the effects of nitrogen deposition. The design and management regimes for these locations will be developed as part of the detailed design, in accordance with the control plan documents including the outline Landscape and Ecology Management Plan (oLEMP) (Application Document 6.7), Design Principles (Application Document 7.5) and the Environmental Masterplan (ES Figure 2.4, Application Document 6.2).

8.3.68 The environmental assessment of these habitat creation areas has reflected a reasonable worst case, for both construction and operation phases. This is described in Chapter 2: Project Description.

8.3.69 The Project proposals at Hole Farm overlap with a legacy project being developed by National Highways for community woodland in the same location. Further information on these proposals is provided in Chapter 2: Project Description.

8.4 Baseline conditions

Current baseline

8.4.1 The baseline conditions for the terrestrial biodiversity study area are described from south to north of the Order Limits. The baseline for nitrogen deposition compensation sites are addressed separately as the scope of surveys for these areas is different to the wider Project.

8.4.2 The current baseline describes the biodiversity features as they were in the years surveyed (2017 to 2022). Due to the land use in this area, and the maintenance of the habitats present, this is considered likely to be representative of the baseline conditions at the start of construction (2024), unless stated otherwise. For ease of reporting, this section has been split into three separate geographical sections: south of the River Thames; the River Thames; and north of the River Thames.

South of the River Thames

Statutory designated sites

8.4.3 There are two designated sites of international importance, eight statutory designated sites of national ecological importance and two statutory designated site of county ecological importance across the study area to the south of the River Thames. These are presented on Figure 8.1 (Application Document 6.2) and are outlined in Table 8.8. Further details regarding their reasons for designation and condition assessments are provided in Table 1.1 of Appendix 8.1: Designated Sites (Application Document 6.).

8.4.4 Air quality assessment has been undertaken in accordance with DMRB LA 105 standards, which assessed the impacts of the Project from construction dust and nitrogen deposition on designated sites within 200m of any construction works, including haul routes, compound areas and soil storage areas to

determine whether it results in a likely significant effect. Additional sites were assessed in relation to air quality where there were likely operational impacts from changes in air quality within 200m of the ARN. Further details of which sites have been considered in relation to the ARN, and which sites were screened in for further assessment can also be found in Appendix 8.1: Designated Sites (Application Document 6.3) and Appendix 8.14: Designated Sites Air Quality Assessment (Application Document 6.3). These additional sites are excluded from Table 8.8 and Table 8.9 below.

8.4.5 The Thames Estuary and Marshes SPA and Ramsar site include areas that are located to the south and north of the shorelines of the River Thames. For ease of reporting and to avoid unnecessary repetition, these statutory designated sites are addressed within the 'River Thames' section of this report.

Table 8.8 Statutory designated sites and associated ancient woodland within the study area south of the River Thames

Designated site	Interest features, citation lists and reasons for designation	Level of importance	Approximate distance from Order Limits
Boxley Warren LNR	The site is noted for its ancient woodland and internationally scarce yew woodland. The Warren supports a fascinating range of flora and fauna.	National	0m
North Downs Woodlands SAC	The site comprises of important grasslands, shrublands and some of the UK's rarest woodland types, especially for the region. In particular, the yew-dominated woodland is a rare habitat of European priority interest restricted to only a few areas of England and Wales, and this SAC is considered one of the best areas.	International	0m
Wouldham to Detling Escarpment SSSI	A mosaic of ancient woodland and grassland habitats. Contains a number of rare and protected plant species. The site supports a rich assemblage of insect species including 20 nationally scarce species.	National	0m
Peter's Pit SAC and SSSI	An old chalk quarry situated in the North Downs, with large ponds situated amongst grassland, scrub and woodland. The SAC is primarily designated for its large GCN population.	International	1,766m
Holborough to Burnham Marshes SSSI	A mosaic of ancient woodland and grassland habitats. Contains a number of rare and protected plant and invertebrate species. The site is particularly noted for its bird assemblage.	National	1,481m

Designated site	Interest features, citation lists and reasons for designation	Level of importance	Approximate distance from Order Limits
South Thames Estuary and Marshes SSSI	Overwintering waterfowl and breeding bird community, including specially protected birds such as hen harrier *Circus cyaneus*, short-eared owl *Asio flammeus*, ruff *Philomachus pugnax*, common tern *Sterna hirundo*, avocet *Recurvirostra avosetta* and golden plover *Pluvialis apricaria.* Habitats, including grazing marsh, dykes and fleets, saltmarsh, mudflats, freshwater pools, shingle and woodland habitats. Invertebrates, including some Nationally Rare and Scarce species.	National	0m (within Order Limits)
Cobham Woods SSSI including Great Wood Ancient Semi-natural Woodland (ASNW)	Ancient woodland and parkland supporting rare plant species and breeding birds.	National	331m (Great Wood ASNW is 23m from the Order Limits)
Shorne and Ashenbank Woods SSSI including Ashenbank, Shorne and Brewers ASNW, Ashenbank Woodland Trust Reserve LWS and Shorne Woods Country Park	Ancient woodland supporting typical indicator plant species as well as rare invertebrate species.	National	0m (within Order Limits)
Great Crabbles Wood SSSI and ASNW	Ancient woodland supporting scarce plants.	National	0m (within Order Limits)
Halling to Trottiscliffe Escarpment SSSI	A mosaic of grassland, scrub and woodland supporting rare plants and invertebrates.	National	1,498m
Swanscombe Peninsula SSSI	Diverse assemblages of breeding birds; assemblages of invertebrates; and populations of rare plant species.	National	670m
Rede Common LNR	Acid grassland, surrounded by scrub and trees, supporting birds, invertebrates and small mammals.	County	1,014m

Non-statutory designated sites

8.4.6 A total of 23 non-statutory designated sites and ancient woodland of ecological importance not associated with a statutory site are located within the study area

to the south of the River Thames, presented on Figure 8.1 (Application Document 6.2). A list of these sites with a description of each is found in Table 8.9, with further detail provided in Appendix 8.1: Designated Sites (Application Document 6.3).

Table 8.9 Non-statutory designated sites and ancient woodland not associated with statutory sites within the study area south of the River Thames

Designated site	Interest features, citation lists and reasons for designation	Level of importance	Approximate distance from Order Limits
Jeskyns LWS	Newly planted woodland and grassland	County	302m
Areas of ancient woodland around A2/M2 junction	Ancient woodland	National	0m (within Order Limits)
Brummelhill Wood ASNW	Ancient woodland.	National	55m
Claylane Wood ASNW	Ancient woodland	National	0m (within Order Limits)
Shorne Pasture LWS	Grassland	County	258m
Court Wood LWS; Starmore Wood ASNW and Peartree Wood ASNW	Ancient and ancient replanted woodland	National	0m (within Order Limits)
Telegraph Hill LWS	Grassland	County	348m
Chilton Hills Wood ASNW	Ancient replanted woodland	National	388m
Ebbsfleet Marshes LWS	Wetland and grassland habitat	County	499m
A226 Gravesend roadside nature reserve (RNR)	Chalk grassland	County	0m (within Order Limits)
A227/A20 London Road RNR	Verge with a range of chalk grassland species.	County	428m
Canal and Grazing Marsh Higham LWS	Open water, reedbed and marshland	County	0m (within Order Limits)
Cole Wood ASNW	Ancient woodland	National	38m
Blue Bell Hill Banks and Verges LWS	Species rich chalk grassland and scrub woodland.	County	105m
Walderslade Woods LWS	Ancient woodland.	National	216m
Frith Woods ASNW, Kits Coty LWS	Ancient woodland	National	0m

Designated site	Interest features, citation lists and reasons for designation	Level of importance	Approximate distance from Order Limits
Frith/Impton Woods ASNW	Ancient woodland.	National	0m
B2015 Branbridges Road RNR	Grassland and ditch with a good assemblage of plants.	County	495m
Impton/Podkin Wood ASNW	Ancient woodland.	National	0m
Warren Road RNR	Shady woodland bank.	County	254m
Westfield Wood ASNW	Ancient woodland.	National	0m
M26/A20 London Road Roundabout RNR	Verge with a range of chalk and neutral grassland species.	County	451m
Burham Down ASNW	Ancient woodland.	National	357m

Plants and habitats

8.4.7 A full description of the plants and habitats baseline conditions is presented in Appendix 8.2: Plants and Habitats (Application Document 6.3). A summary of the key plant and habitat features present within the ZoI to the south of the River Thames is provided in Table 8.10.

Table 8.10 Summary evaluation of the plants and habitats to the south of the River Thames

Habitat/species	Level of importance	Justification
Ancient woodland	National	• Ancient woodland is an irreplaceable habitat and therefore meets the DMRB LA 108(Highways England, 2020a) criteria for being of national importance, as outlined in Table 8.5. • The habitat is also included as a 'lowland mixed deciduous woodland' Habitat of Principal Importance (HoPI) in line with the requirements of section 41 of the NERC Act 2006. • Woodland and scrub are also included as priority habitat on the Kent BAP (Kent BAP Steering Group, 1997).
Ancient and veteran trees	National	• Ancient and veteran trees are an irreplaceable habitat and therefore meet the DMRB (Highways England, 2020a) criteria for being of national importance, as outlined in Table 8.5.
Semi-natural broadleaved woodland	County	• Habitat is listed as a 'lowland mixed deciduous woodland' HoPI in line with the requirements of section 41 of the NERC Act 2006. However, this habitat is common and widespread throughout the ZoI and the wider landscape and is therefore considered to be of county importance. • Woodland and scrub is also a priority habitat on the Kent BAP (Kent BAP Steering Group, 1997) and therefore meets the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5.
Plantation woodland	County	• Despite being structurally poor with limited species diversity, woodland and scrub is included as a priority habitat on the Kent BAP (Kent BAP Steering Group, 1997) and therefore meets the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5.
Scrub	County	• Despite being a common and widespread habitat throughout the ZoI and throughout the surrounding landscape, woodland and scrub is a priority habitat on the Kent BAP (Kent BAP Steering Group, 1997) and therefore meets the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5.
Scattered and parkland trees (not considered veteran)	National	• The scattered and parkland trees within Cobham Hall School are included as 'wood-pasture and parkland' in line with the requirements of section 41 of the NERC Act 2006 and therefore meet the DMRB (Highways England, 2020a) criteria for being of national importance, as outlined in Table 8.5. • These areas are also wood-pasture and historic parkland priority habitat on the Kent BAP (Kent BAP Steering Group, 1997).

Habitat/species	Level of importance	Justification
	Local	• The remaining scattered trees are common and widespread throughout the ZoI and surrounding landscape. • This habitat is likely to appreciably enrich the habitat resource within the local context, supporting species and features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.
Neutral grassland	County	• Larger areas of neutral grassland is included as a priority habitat on the Kent BAP (Kent BAP Steering Group, 1997) and therefore meets the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5.
	Local	• Includes small fragments along tracks and roadsides. • This habitat is common and widespread throughout the ZoI and the surrounding landscape. • This habitat is likely to appreciably enrich the habitat resource within the local context, supporting species and features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.
Calcareous grassland	County	• Chalk grassland is included as a priority habitat on the Kent BAP (Kent BAP Steering Group, 1997) and therefore meets the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5.
Improved grassland	Local	• This habitat is common and widespread throughout the ZoI and the surrounding landscape. • It is structurally poor, heavily modified and supports a low species diversity. • This habitat is likely to appreciably enrich the habitat resource within the local context, supporting species and features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.
Marshy grassland	County	• Neutral and marshy grassland is included as a priority habitat on the Kent BAP (Kent BAP Steering Group, 1997) and therefore meets the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5. • Contains notable plant species lesser spearwort *Ranunculus flammula.*

Habitat/species	Level of importance	Justification
Species-poor semi-improved grassland	Local	• The majority of this habitat is common and widespread throughout the ZoI and the surrounding landscape. • This is likely to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.
Continuous bracken	No appreciable importance	• Common and widespread habitat that is structurally poor and of low species diversity. • Only a very small area is present within the ZoI (0.25ha). • This is not considered to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange.
Tall ruderal herbs	No appreciable importance	• Common and widespread habitat that is structurally poor and of low species diversity. • Only small areas are present within the ZoI (11.28ha). • This is not considered to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange.
Swamp and marginal vegetation	County	• An area of reedbed is located within the Canal and Grazing Marsh Higham LWS. Reedbed is listed as a HoPI in line with the requirements of section 41 of the NERC Act 2006 and as Reedbed priority habitat on the Kent BAP (Kent BAP Steering Group, 1997). However, as this small area of reedbed sits within a LWS, a county value has been assigned to the wider swamp and marginal vegetation habitat type recorded there. • Contains single records of notable plant species golden dock *Rumex maritimus*, marsh ragwort *Senecio aquaticus*, parsley water-dropwort *Oenanthe lachenalii* and sharp rush *Juncus acutus*.
	Local	• Other areas of swamp and marginal vegetation are common and widespread within the ZoI, and are structurally poor and of low species diversity. • This is likely to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.

Habitat/species	Level of importance	Justification
Standing water (ponds)	County	• This habitat is included as pond HoPI in line with the requirements of Section 41 of the NERC Act 2006. However, this habitat is common and widespread throughout the study area and the wider landscape and is therefore not considered of national importance. • Standing water is a priority habitat on the Kent BAP (Kent BAP Steering Group, 1997) and therefore meets the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5.
Standing water (lakes and reservoirs)	County	• This habitat is included as standing water priority habitat on the Kent BAP (Kent BAP Steering Group, 1997) and therefore meets the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5.
Standing water (ditches)	Local	• This habitat is included as standing water priority habitat on the Kent BAP (Kent BAP Steering Group, 1997). However, ditches are common and widespread within the ZoI and wider landscape, so are considered likely to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5. • Contains few notable plant species such as frogbit *Hydrocharis morsus-ranae* and mare's-tail *Hippuris vulgaris*.
Standing water (canal)	County	• This habitat is included as standing water priority habitat on the Kent BAP (Kent BAP Steering Group, 1997) and therefore meets the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5.
Running water	County	• Rivers and streams are included as a priority habitat on the Kent BAP (Kent BAP Steering Group, 1997), therefore this habitat meets the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5.
Coastal	National	• Coastal saltmarsh, coastal vegetated shingle and intertidal mudflats are listed as HoPIs in line with the requirements of section 41 of the NERC Act 2006. Saltmarsh, vegetated shingle, intertidal mud and sand are listed as priority habitats on the Kent BAP (Kent BAP Steering Group, 1997), therefore these habitats meet the DMRB (Highways England, 2020a) criteria for being of national importance, as outlined in Table 8.5. • Notable species present include common sea-lavender *Limonium vulgare* and golden-samphire *Inula crithmoides*.

Habitat/species	Level of importance	Justification
Arable	Local	• This habitat is common and widespread throughout the ZoI and the surrounding landscape. • It is of low species diversity, comprising frequently cultivated and disturbed land. • Not known to support any notable species within the ZoI. • This habitat is likely to appreciably enrich the habitat resource within the local context, supporting species and features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.
Amenity grassland	No appreciable importance	• Common and widespread habitat of low species diversity and poor structural integrity. • This is not considered to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange.
Ephemeral/short perennial	Local	• Small areas of habitat (1.50ha). • This habitat is likely to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.
Hedgerows (native)	County	• Hedgerow are listed as HoPI in line with the requirements of Section 41 of the NERC Act 2006. However, this habitat is common and widespread throughout the ZoI and the wider landscape and is therefore not considered of national importance. • Hedgerows are included as a priority habitat on the Kent BAP (Kent BAP Steering Group, 1997), therefore this habitat meets the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5. • Contains notable plant species chicory *Cichorium intybus*.
Hedgerows (non-native)	No appreciable importance	• Species-poor and comprising non-native species only. • This habitat is not considered to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange.

Habitat/species	Level of importance	Justification
Open mosaic habitats	National	• Open mosaic habitats on previously developed land are listed as HoPI in line with the requirements of Section 41 of the NERC Act 2006. • Included as an urban priority habitat on the Kent BAP (Kent BAP Steering Group, 1997) and therefore meets the DMRB (Highways England, 2020a) criteria for being of national importance, as outlined in Table 8.5.
Coastal and floodplain grazing marsh	National	• Coastal and floodplain grazing marsh are listed as a HoPI in line with the requirements of section 41 of the NERC Act 2006. • Grazing marsh is a priority habitat on the Kent BAP (Kent BAP Steering Group, 1997) and therefore meets the DMRB (Highways England, 2020a) criteria for being of national importance, as outlined in Table 8.5.
Other habitats including bare ground and buildings	No appreciable importance	• These habitats are common and widespread throughout the ZoI and throughout the surrounding landscape and do not appreciably enrich the habitat resource within the local context. • Unlikely to support features of importance for migration, dispersal, or genetic exchange of species.
Lichen assemblage within study area	Local	• Some notable lichens associated with ancient woodland habitats present. • Not a qualifying feature of designating sites within the ZoI. • Common and widespread species present. • With the presence of common and widespread species, the populations could appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal and genetic exchange.
Bryophyte assemblage throughout the study area	No appreciable importance	• The bryophyte flora was typical for Kent woodland and the species recorded were common and widespread. • The species populations or communities are not considered likely to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange.

Habitat/species	Level of importance	Justification
Invasive Non-Native Species (INNS)	No appreciable importance	• Included on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended). • Included on Schedule 2 of the Invasive Alien Species (Enforcement and Permitting) Order 2019. • Areas of habitat, species populations or communities are not considered likely to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange. • INNS are likely to have an adverse effect on biodiversity by reducing the composition and diversity of native species and habitats.

Terrestrial invertebrates

8.4.8 A full description of the terrestrial invertebrates baseline conditions is presented in Appendix 8.3: Terrestrial Invertebrates (Application Document 6.3). This includes a review of desk-study information and designated sites; the rationale for selecting a range of invertebrate survey areas for further surveys; and invertebrate survey and importance categorisation methodologies and results.

8.4.9 To the south of the River Thames, three survey areas (Survey Areas 1, 2 and 12) were identified as being suitable for potentially supporting invertebrate assemblages of notable conservation value, and so worthy of targeted surveys and assessment. These are presented on Figure 8.7 (Application Document 6.2). They represent the best and most suitable areas within this study area for terrestrial invertebrates. Other terrestrial invertebrates and invertebrate assemblages outside these survey areas to the south of the River Thames would be affected by the Project but are considered to be of no appreciable importance.

8.4.10 Within these invertebrate survey areas, woodland invertebrate assemblages such as those associated with arboreal, shaded woodland floor and decaying wood habitats were represented. These were considered of no more than local ecological importance, since they would be likely to only enrich the habitat resource within the local context and did not include any rare or threatened species, or species that are included within county (or greater) area plans or strategies.

8.4.11 Invertebrate assemblages of greater ecological importance, which were associated with open, early successional habitats such as open short sward habitats and a rich flower resource, were well represented and are summarised in Table 8.11.

8.4.12 Survey Areas 1 and 12 were considered important at a national level due to the presence of Nationally Rare and Scarce invertebrate species and assemblages of high conservation value, where the loss of these populations would adversely affect the conservation status or distribution of the species at a national scale. Survey Area 2 was considered important at a regional level, due to the presence of Essex Red Data Book 'Regionally Important' species. This is outlined further in Table 8.11.

Table 8.11 Baseline conditions for invertebrate survey areas south of the River Thames

Survey area	Broad description	Associated designated site with invertebrate interest	Recorded species with recognised conservation status*	Supported Pantheon invertebrate assemblages**	Level of importance
Area 1: Shorne, Ashenbank and Brewers Woods	Broadleaved ancient woodland with veteran and mature stands, standing and fallen dead wood, wet woodland, scrub, water bodies, tracks and rides	Shorne and Ashenbank Woods SSSI; Shorne and Ashenbank ancient woodland parcels (including Ashenbank Wood ASNW, Shorne/Brewers Woods ASNW and Shorne Woods Country Park ASNW)	Thirteen species (out of 303 recorded (4.3%)), including: two Red Data Book (RDB3); eight Nationally Scarce; one RDBK; one Essex RDB 'Regionally important' and one section 41 species	'Rich flower resource' invertebrate assemblage of high conservation value. Also supported were habitat level 'arboreal', 'shaded woodland floor', 'decaying wood', 'short sward & bare ground' and 'tall sward & scrub' invertebrate assemblages of relatively low conservation value.	National
Area 2: Claylane Wood	Semi improved neutral grassland, scrub and ruderal vegetation surrounding ancient broadleaved woodland which contains tracks/rides	Claylane Wood ASNW	Twenty-nine species (out of 414 recorded (7%)), including: one RDB3, IUCN Near Threatened, section 41 species; four RDB3; and 20 Nationally Scarce species	Habitat level 'tall sward & scrub', 'short sward & bare ground', 'arboreal', 'shaded woodland floor' and 'decaying wood' invertebrate assemblages were well represented within this area. Specific 'scrub edge', 'open short sward' and 'rich flower resource' invertebrate assemblages supported within this area exceeded their corresponding favourable condition threshold.	Regional

Survey area	Broad description	Associated designated site with invertebrate interest	Recorded species with recognised conservation status*	Supported Pantheon invertebrate assemblages**	Level of importance
Area 12: Metropolitan Police firing range and Filborough Marshes	Filborough Marshes - coastal and floodplain grazing marsh with a network of ditches running through cattle grazed semi-improved grassland	Thames Estuary and Marshes Ramsar site; South Thames Estuary and Marshes SSSI; Canal and Grazing Marsh Higham (LWS)	No field surveys carried out: the diverse habitats within the Thames Estuary and Marshes Ramsar site, and South Thames Estuary and Marshes SSSI (over half of Area 12 is within this SSSI) supported a number of Nationally Rare and Scarce invertebrate species.		National***

* **RDB3** (Rare): Pre 1994 classification – Species which are not currently either Endangered or Vulnerable, are at risk and exist in 15 or fewer 10km squares. **RDBK** (Insufficiently Known): Pre 1994 classification – Species suspected to merit either Endangered, Vulnerable, Rare or Indeterminate status but lacking enough information. **IUCN Near Threatened**: Post 1994 IUCN threat guidelines – Species which do not qualify as Endangered or Vulnerable now but likely to qualify in the near future. **Nationally Scarce**: Post 1994 GB rarity status – Species which have been recorded from more than 16 and no more than 100 10km squares in the UK. **Section 41**: Species of principal importance, listed in accordance with the requirements of section 41 of the NERC Act 2006.

** Pantheon is a database tool developed by Natural England and the Centre for Ecology & Hydrology to analyse invertebrate sample data. This information can be used to determine site quality by revealing whether the species list is indicative of good quality habitat, inform on species ecology and assist in management decisions by revealing the key ecological resources (Webb *et al.*, 2017).

*** Assessment based on desk-study information. Field surveys were not undertaken at Filborough Marshes due to the minimal impact the Project would have in this location.

Freshwater species

8.4.13 A full description of the baseline conditions relating to freshwater ecology is presented in Appendix 8.4: Freshwater Ecology (Application Document 6.3).

Macro-invertebrates

8.4.14 The proposed site for the South Portal is situated 1km south of the Thames Estuary SPA and Ramsar site, while the Project route passes under the western section of the designated area. The Ramsar site is known to support freshwater invertebrate species of conservation interest including one endangered, 10 vulnerable and 12 rare species (Ramsar Information Sheet, 2000). As the ditch habitats across the study area are linked and uniform in nature, these have been considered as a single receptor.

8.4.15 Aquatic macro-invertebrates listed in the Ramsar designation are detailed in Table 8.12 which shows the individual Conservation Score (CS) (Chadd and Extence, 2004) for the species recorded, following the methodology described in Appendix 8.4: Freshwater Ecology (Application Document 6.3). The conservation statuses and Red Data Book scores have been taken account of when assessing the importance of the assemblage.

Table 8.12 Macro-invertebrates cited in the Thames Estuary SPA and Ramsar site designation (Joint Nature Conservation Committee (JNCC), 2004)

Species	Group	CS conservation status	RDB score
Bagous longitarsis	Coleoptera (beetles)	Endangered	1
Erioptera bivittata	Cranefly	Vulnerable	2
Lestes dryas	Damselfly	Vulnerable	2
Cercyon bifenestratus	Coleoptera	Rare	3
Hydrochus elongatus	Coleoptera	Rare	3
Hydrochus ignicollis	Coleoptera	Rare	3
Ochthebius exaratus	Coleoptera	Rare	3
Hydrophilus piceus	Coleoptera	Rare	3
Stratiomys longicornis	Soldier fly	Rare	3

8.4.16 Macro-invertebrate surveys were carried out within the Thames Estuary and Marshes Ramsar area at sites within a 1km radius of the South Portal. Surveys took place in August 2018 on five ditches using Environment Agency standardised methodology. A further five ditches were sampled in autumn 2021, spring 2022 and summer 2022. Samples collected were taken back to the laboratory for species-level analysis.

8.4.17 Samples showed high macro-invertebrate diversity across all sites in 2018, with a lower diversity reported from sites sampled in 2021/2022. Full details are shown in Appendix 8.4: Freshwater Ecology (Application Document 6.3). Macro-invertebrates of ecological importance that were recorded are shown in Table 8.13. Both *Hydrochus ignicollis* and *Stratiomys longicornis*, which are cited in the Ramsar designation, were recorded.

Table 8.13 Macro-invertebrates of conservation importance

Location	Species present	Group	Abundance	Conservation importance	Red Data Book score
J2	*Berosus affinis*	Coleoptera (beetles)	20	Notable	N/A
	Hydroglyphus geminus	Coleoptera	1	Notable	N/A
J3	*Berosus affinis*	Coleoptera	5	Notable	N/A
	Hydraena testacea	Coleoptera	2	Notable	N/A
	Hydrochus ignicollis	Coleoptera	4	Rare	RDB3
J4	*Stratiomys longicornis*	Soldier fly larvae	1	Vulnerable	RDB2
J5	*Berosus affinis*	Coleoptera	1	Notable	N/A
	Hydrochus ignicollis	Coleoptera	1	Rare	RDB3
MP1	*Agabus conspersus*	Coleoptera	2	Notable	n/a
	Rhantus frontalis	Coleoptera	1	Notable	n/a

8.4.18 Due to the presence of several notable, vulnerable and rare species of conservation importance, which are likely to form part of a wider county population, the assemblage of macro-invertebrates within the study area to the south of the River Thames is considered to be of county importance for biodiversity.

Macrophytes

8.4.19 Macrophyte surveys were undertaken at Filborough Marshes within the Thames Estuary and Marshes Ramsar site and the South Thames Estuary and Marshes SSSI. The macrophyte, water soldier *Stratiotes aloides*, which falls within Criterion 2 of the Thames Estuary and Marshes Ramsar site designation (JNCC, 2018), was not recorded during the surveys. Only one species of conservation interest was reported; the sharp rush *Juncus acutus* which is considered rare in Kent. The assemblages of macrophytes recorded across the ditches surveyed in 2018 were very consistent, dominated by aquatic plants including duckweed species, rigid hornwort *Ceratophyllum demersum* and soft hornwort *Ceratophyllum submersum*, which are typically associated with the ditch-like habitat recorded.

8.4.20 Nine of the 17 ditches surveyed in 2018 reported the presence of INNS: New Zealand pigmyweed *Crassula helmsii*, and water fern *Azolloa filiculoides*.

8.4.21 Macrophyte surveys were undertaken at a further four sites in July 2022. These sites demonstrated high overall macrophyte cover, with no species of conservation value or non-natives reported. Diversity metrics were low, and nutrient tolerances high within species recorded.

8.4.22 Although the Ramsar site is of international importance, the macrophyte assemblage within the Project study area is considered to be of county importance for biodiversity. This is because the assemblage is likely to form a critical part of the wider county population and the loss of it would be likely to

adversely affect the conservation status or distribution of macrophytes at a county scale.

Fish

8.4.23 Fish within the study area to the south of the River Thames were scoped out due to a lack of suitable habitat that would be likely to support populations or communities of species considered to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal or genetic exchange (see Appendix 8.4: Freshwater Ecology (Application Document 6.3).

Amphibians

8.4.24 A full description of the baseline conditions relating to amphibians is presented in Appendix 8.5: Amphibians (Application Document 6.3). A summary of the key amphibian features present within the study area to the south of the River Thames is provided below.

Great crested newt

8.4.25 The desk-based study returned 26 records for GCN within 2km of the Order Limits within the last 10 years. The closest records were within Shorne and Ashenbank Woods and Cobham Hall Independent School. One non-designated site, Ebbsfleet Marshes LWS is located within 500m of the Order Limits. However, GCN populations associated with this site are considered unlikely to be present within the Order Limits, due to the lack of suitable connective habitat between the populations and the Order Limits.

8.4.26 Of the 125 ponds initially identified though desk study and Phase 1 walkover surveys, GCN presence was confirmed or assumed at 33 ponds within the GCN study area (presence has been assumed on a precautionary basis where access to the pond has not been feasible or survey results were inconclusive). Where ponds were within close proximity to each other and there is good habitat connectivity and the absence of physical barriers, populations are considered to comprise the same metapopulation. As such, four metapopulations were identified and are outlined in Table 8.14 below. Where population size has been assumed, a full justification has been provided in Appendix 8.5: Amphibians (Application Document 6.3).

Table 8.14 Summary of GCN populations south of the River Thames

Population	Population size	Description
S1	Medium	Metapopulation of eight ponds
S2	Large	Metapopulation of 11 ponds spread over Shorne Woods
S3	Small (assumed)	A single breeding pond, no adults found, only GCN eggs found
S4	Large (assumed)	Metapopulation of 14 ponds

8.4.27 The habitats within the GCN study area comprise mainly ancient semi-natural broadleaved woodland, neutral grassland, species-poor semi-improved grassland and hedgerows. These habitats provide potentially suitable terrestrial habitat for GCN.

8.4.28 Given these findings, the conservation status of GCN, and Kent being considered as a stronghold for GCN (Kent Reptile and Amphibian Group, 2019), the populations of GCN within the study area to the south of the River Thames are considered to be of county importance for biodiversity. Furthermore, the GCN population within the study area is likely to form a critical part of the wider county population, being important for genetic exchange at this scale. The loss of it would therefore be likely to adversely affect the conservation status and distribution of GCN at a county scale.

Common toad

8.4.29 There were 11 recent desk-study records for common toad *Bufo bufo* within 2km of the Order Limits to the south of the River Thames.

8.4.30 All standing water, including the ponds identified during the GCN surveys, are considered potentially suitable breeding habitat for common toad. The ancient and broadleaved woodland, neutral and marshy grassland and hedgerow habitats provide potentially suitable terrestrial habitat for common toad.

8.4.31 Common toad were recorded on four occasions within the Order Limits during the GCN surveys.

8.4.32 Based on a review of desk-study information, incidental sightings, habitat suitability assessment and conservation status, the likely population of common toad south of the River Thames is considered to be of local importance for biodiversity, since the population within the study area is not likely to form a critical part of the county population.

Reptiles

8.4.33 Reptile survey data was analysed using the criteria for Key Reptile Area selection as shown in Table 8.15. This allows the classification of the relative size of reptile populations on the basis of peak survey counts (the maximum number of adults seen by observation and/or under refugia (placed at a density of up to 10 per hectare), by one person in one day) to obtain an objective evaluation of the importance of the reptile interest in each survey area (Froglife, 1999).

Table 8.15 Reptile population size category and score matrix

Species	Low population	Good population	Exceptional population
	Score 1	***Score 2***	***Score 3***
Adder	<5	5–10	>10
Grass snake	<5	5–10	>10
Common lizard	<5	5–10	>20
Slow-worm	<5	5–10	>20

8.4.34 To qualify as a key reptile area, the survey area must meet at least one of the following criteria (Froglife, 1999). This criterion was used to inform the valuation of the assemblages as detailed in paragraph 8.4.38:

a. Supports three or more reptile species

b. Supports two snake species

c. Supports an exceptional population of one species

d. Supports an assemblage of species scoring at least four using the Froglife matrix (1999), (refer to Appendix 8.6: Reptiles (Application Document 6.3))

8.4.35 To the south of the River Thames, low to good populations of three common reptile species were recorded (grass snake *Natrix natrix*, slow-worm *Anguis fragilis* and common lizard *Zootoca vivipara*). These reptiles were identified within 10 different sites, with one of these sites identified as a key reptile area. This location was the Metropolitan Police firing range, which was found to support a low population of grass snake and good populations of slow-worm and common lizard.

8.4.36 The Metropolitan Police firing range therefore met two of the above criteria, supporting three species of reptiles and supporting an assemblage that scored five on the Froglife (1999) matrix (refer to Appendix 8.6: Reptiles (Application Document 6.3)).

8.4.37 The habitats within the study area comprise mainly ancient semi-natural broadleaved woodland, neutral grassland, species-poor semi-improved grassland and hedgerows. These provide potentially suitable habitat for reptiles. Further details regarding the reptile baseline conditions are provided in Appendix 8.6: Reptiles (Application Document 6.3).

8.4.38 The reptile assemblage is valued at county level importance, since the population within the study area is likely to form a critical part of the wider county population, being important for genetic exchange at this scale. The loss of the reptile population within the study area would therefore be likely to adversely affect the conservation status and distribution of reptiles at a county scale. Furthermore, reptiles:

a. are legally protected under the Wildlife and Countryside Act 1981 (as amended)

b. are listed in accordance with the NERC Act 2006 as species of principal importance for the purpose of conserving biodiversity

c. are under threat in the UK, particularly from habitat loss and isolation of populations

d. are suffering population declines in the UK

e. have population strongholds in Kent, with good quality habitat for reptiles within part of the Order Limits, most notably within the Metropolitan Police firing range

Ornithology

8.4.39 Holborough to Burham Marshes SSSI is designated in part for its bird interest. This includes species associated with the fen and swamp habitat including bearded tit *Panurus biarmicus,* grazing marsh including lapwing *Vanellus vanellus* and redshank *Tringa totanus*. In the scrub there are breeding populations of both grasshopper warbler *Locustella naevia* and nightingale *Luscinia megarhynchos.* Wintering birds include teal *Anas crecca*, shelduck *Tadorna tadorna*, snipe *Gallinago gallinago*, and wigeon *Anas penelope*.

8.4.40 Cobham Woods SSSI is located to the south of the River Thames and is noted for its ornithological interests. This site comprises woodland, old parkland and an area of arable land that is primarily designated for the plant assemblage, but also for '*a good variety of typical woodland* [bird] *species*' (Natural England, 1984).

8.4.41 Swanscombe Peninsula SSSI is designated in part for its breeding bird interest. This includes species associated with the fen and swamp habitat including bearded tit*,* marsh harrier *Circus aeruginosus,* grazing marsh including lapwing and pochard *Aythya ferina*. In the scrub there are breeding populations of both grasshopper warbler and nightingale.

8.4.42 Although the Thames Estuary and Marshes SPA and Ramsar site are mostly relevant to the River Thames section of this chapter, the boundaries of these sites overlap with this geographical section, therefore their habitats are relevant to the ornithology baseline conditions here. Within the study area to the south of the River Thames, this site primarily comprises coastal grazing marsh and saltmarsh, as well as areas of reedbed and semi-improved grassland. Table 8.17 outlines a summary of these designated sites and their associated ornithological features.

8.4.43 In addition to the area within the Thames Estuary and Marshes SPA and Ramsar site, and the wider area of functionally linked land associated with these designated sites, the habitats that are most suitable for birds south of the River Thames can be grouped into two key areas:

a. Arable farmland to the east of Gravesend

b. Woodland in the vicinity of the A2

8.4.44 Three qualifying species of the Thames Estuary and Marshes SPA and Ramsar site were recorded where the study area to the south of the River Thames overlaps with the boundaries of the designated sites, namely black-tailed godwit *Limosa limosa*, knot *Calidris canutus* and redshank. These areas supported 13 other species that are non-qualifying species of the designated sites, but which are otherwise noteworthy, being either specifically listed as forming part of the assemblage qualification, being species of conservation concern (Eaton *et al.,* 2015) and/or included on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). Further details regarding those species are included within Appendix 8.7: Ornithology (Application Document 6.3).

8.4.45 The areas that are classified as functionally linked land associated with the Thames Estuary and Marshes SPA and Ramsar site were not found to support any qualifying species of these sites. They were found to support seven waterbird species which are either specifically listed as forming part of the assemblage qualification, or otherwise noteworthy (Appendix 8.7: Ornithology (Application Document 6.3)).

8.4.46 The areas that form a part of the Thames Estuary and Marshes SPA and Ramsar site and their functionally linked land were also found to support a notable assemblage of other bird species (particularly within the RSPB reserve of Shorne Marshes). Notable breeding (probable or confirmed) species recorded here included those that are listed as being species of conservation concern (Eaton *et al.*, 2015) or on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended), namely marsh harrier and cuckoo *Cuculus canorus*. Bearded tit were also reported as breeding within Shorne Marshes (RSPB, personal communication, 2019), though were not recorded during field surveys. Notable wintering species recorded here included curlew *Numenius arquata* and wigeon.

8.4.47 The arable farmland and woodland habitats beyond the Thames Estuary and Marshes SPA and Ramsar site and their functionally linked land, supported bird assemblages that are typical for these habitat types in the south-east. However, those assemblages did include the notable species, cuckoo, meadow pipit *Anthus pratensis* and skylark *Alauda arvensis* within the farmland habitats; and marsh tit *Poecile palustris*, mistle thrush *Turdus viscivorus* and bullfinch *Pyrrhula pyrrhula* in the woodland habitats. Other species listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) were also recorded breeding within the study area, including one pair of peregrine *Falco peregrinus*, and Cetti's warbler *Cettia cetti*, which were recorded throughout the areas of wetland habitat.

8.4.48 Barn owl were recorded foraging across Shorne Marshes and the Metropolitan Police firing range adjacent to the south bank of the River Thames on three occasions; no evidence of breeding was observed. The individuals are likely to be part of the Essex population (one record was of an individual carrying food from Shorne Marshes to the north side of the River Thames). At most, the population of barn owl within the study area to the south of the River Thames could represent approximately 3.44% of the population in Kent (29 individuals (Kent Ornithological Society, 2019)) and 0.03% of the population in UK (estimated 4,000 pairs (Toms *et al.,* 2001)). However, this is considered unlikely given the evidence referenced above, which suggests those recorded individuals are more likely part of the Essex population (i.e. individuals observed carrying food to the north side of the River Thames). The barn owl population within the study area to the south of the River Thames is therefore considered to be of no appreciable importance, since it is unlikely to form a critical part of the local (or wider) population.

8.4.49 Since barn owls that were observed within the study area to the south of the River Thames are most likely to be associated with the population residing to the north of the River Thames, likely significant effects on barn owls to the south of the River Thames would not occur. This species is therefore considered further within the 'north of the River Thames' sections of this report.

8.4.50 Marsh harrier were recorded foraging and confirmed breeding (one pair) in the marshes and reedbeds adjacent to the south bank of the River Thames. The population of marsh harrier within the area south of the River Thames represents 2.8% of the breeding population in Kent (36 pairs), 2.0% of south-east England (49 pairs) and 0.44% of the English breeding population (224 pairs); the population in Kent represents 73% of the south-east region. This population is therefore considered to be of county importance, since it is unlikely to form a critical part of the county population and the loss of it would be unlikely to adversely affect the conservation status and distribution of marsh harriers at a county scale.

8.4.51 The general assemblage of breeding and non-breeding birds within the study area to the south of the River Thames is considered to be of county importance. This is because it supported species that are likely to form a critical part of the county assemblage of birds and the loss of these populations would be likely to adversely affect the conservation status and distribution of birds at a county scale. Furthermore, the assemblage supports species that form qualifying features of the Thames Estuary and Marshes SPA and Ramsar site, species which are included as part of the qualifying bird assemblage of the designated sites, as well as other species of conservation concern that are either uncommon and/or specially protected under Schedule 1 of the Wildlife and Countryside Act 1981 (as amended).

Bats

8.4.52 There are no statutory designated sites for which bats are listed as a notifiable feature within 2km of the Order Limits. There are no non-statutory designated sites within 500m of the Order Limits. Desk-study records identified 12 species and included hibernation roosts for five individual species and four species groups.

8.4.53 Woodland assessments for roosting bats were carried out in nine woodlands south of the River Thames. Of these, six were identified as having a high value to roosting bats (Ashenbank Wood, Shorne Woods, woodland at the north-western corner of Shorne Woods, woodland adjacent to Thong Lodge, Claylane Wood, Cobham Hall Wood) whilst three were of a moderate value (Rochester and Cobham Park Golf Club, Brewers Wood, Gravelhill Wood). The criteria for determining the value of woodland for bats is given within Appendix 8.8: Bats (Application Document 6.3).

8.4.54 Bat surveys recorded a minimum of six species within the ZoI.

8.4.55 There were bat roosts confirmed at eight locations within the study area to the south of the River Thames. Of the eight locations, five were in structures: St Mary's Church, Marling Manor, 1 Longview and two air raid shelters in Shorne Woods. St Mary's Church and Marling Manor were found to support an assumed brown longed eared bat *Plecotus auritus* day roost. The roost at 1 Longview was identified as a common pipistrelle *Pipistrellus pipistrellus* day roost. The roosts within the air raid shelters were identified through desk-study as brown long-eared bat and Natterer's bat *Myotis nattereri* hibernation roosts, whilst the internal inspection confirmed it to be a Daubenton's bat *Myotis daubentonii* hibernation roost as well.

8.4.56 Surveys in October 2019 at Muggins Chalk Pit, a disused chalk quarry recorded an unidentified bat in torpor roosting and another bat, likely a common

pipistrelle flying within the lime kiln tunnels. This suggests that Muggins Chalk Pit is being used as a transitionary and hibernation roost. Desk-study data provided records of brown long-eared bats, Natterer's bat, Daubenton's bat, and small *Myotis* bats hibernating in low numbers.

8.4.57 There were two trees identified as supporting roosting bats within the study area to the south of the River Thames. Tree 284 within the Order Limits was identified as a single soprano pipistrelle *Pipistrellus pygmaeus* day roost and a probable brown long-eared day roost. Tree 911 was within 50m of the Order Limits and a single noctule *Nyctalus noctule* was found, confirming it as a day roost. In addition, there were a further 67 high and 128 moderate suitability trees for roosting bats identified within the Order Limits and 50m buffer.

8.4.58 Of the areas surveyed for bat activity, Ashenbank Wood had relatively high levels of bat activity and Shorne Woods, Rochester and Cobham Park Golf Club, and a mature hedgerow west of Shorne Woods had relatively moderate levels of bat activity. The vast majority of bat activity was from the pipistrelle species group, accounting for over 90% of activity across all static detectors combined. The crossing point surveys identified all three locations as being used by moderate numbers of pipistrelle and big bat species (see Figure 8.25 for exact locations (Application Document 6.2)).

8.4.59 Over 90% of bat activity onsite was from common species with the remaining being rarer species. No maternity roosts were identified onsite and the hibernation roosts onsite only contained low numbers of bats. The hibernation roost of small *Myotis* species was considered likely to be the more widespread and common whiskered *Myotis mystacinus* or Brandt's bats *Myotis brandti*.The bat population within the ZoI to the south of the River Thames could form a critical part of the county population, and as such is of county importance .

8.4.60 Further details regarding the bat baseline conditions are presented in Appendix 8.8: Bats (Application Document 6.3).

Dormice

8.4.61 The dormouse surveys of the study area to the south of the River Thames returned 52 dormouse nests and a total of 35 individuals, predominantly located within the designated woodland sites in close proximity to the A2, but also within the scrub and hedgerows on Southern Valley Golf Course. Although dormouse were only confirmed as present within these woodland areas, they are likely to be located in any suitable habitat within the A2 corridor, particularly the scrub alongside the road verges.

8.4.62 Although dormouse are relatively widespread within Kent, given their conservation status, the population within the ZoI to the south of the River Thames could form a critical part of the county population, and as such is of county importance.

8.4.63 Further details regarding the dormouse baseline conditions are presented in Appendix 8.9: Dormouse (Application Document 6.3).

Water voles

8.4.64 The water vole surveys of the study area to the south of the River Thames found that there was a large population located within the ditches and streams

within the Thames Estuary and Marshes Ramsar site and the RSPB Shorne Marshes reserve immediately south of the River Thames. The large population of water vole within the ZoI to the south of the River Thames, and the connection within the wider water vole population, is likely to form a critical part of a wider regional population and is therefore considered to be of regional importance. Furthermore, water voles:

a. are legally protected under Schedule 5 of the Wildlife and Countryside Act 1981

b. are listed as endangered in England under the IUCN Red List

c. are a Kent priority species and listed as a Species of Principal Importance under section 41 of the NERC Act 2006

d. are under threat in the UK

8.4.65 Further details regarding the water vole baseline conditions are presented in Appendix 8.10: Water Vole (Application Document 6.3).

Otters

8.4.66 A single potential otter spraint was located south of the River Thames within the Thames Estuary and Marshes Ramsar site. As this was the only potential record of otter south of the river, it is considered unlikely that otter are resident in this area. However, given that otter are not a widely abundant species within the local area, the population of otters within the study area is, on a precautionary basis, considered to be of local importance.

8.4.67 Further details regarding the otter baseline conditions are presented in Appendix 8.11: Otter (Application Document 6.3).

Badgers

8.4.68 Badgers were recorded across the study area to the south of the River Thames. There were nine main setts identified, with eight of these located in the woodlands around the A2 corridor. The remaining main sett was located to the east of Shorne village. In addition, there were a further 105 non-main setts (annex, subsidiary and outlier setts) located within 500m of the Order Limits south of the River Thames.

8.4.69 Although not considered to be a species of conservation concern, badger and their setts are nonetheless afforded legal protection under the Protection of Badgers Act 1992. Badger are therefore regarded as an ecological feature of local importance.

8.4.70 Further details regarding the badger baseline conditions are presented in Appendix 8.12: Badger (Confidential) (Application Document 6.3).

Other notable mammals

8.4.71 Of the three species of mammals considered as part of this assessment (brown hare, harvest mouse and hedgehog), brown hare and harvest mouse were not recorded from surveys. Hedgehog are likely to be found in small numbers given the limited amount of suitable habitat within the study area; and there were 13

desk-study records within the ZoI south of the River Thames. However, no incidental observations of hedgehog were made during any of the nocturnal ecology surveys, such as those for bats, GCN or birds.

8.4.72 Given the likely small populations or absence of other mammals within the ZoI to the south of the River Thames, none are considered to be of appreciable importance and are therefore not considered further in this assessment.

8.4.73 Further details regarding baseline conditions of other mammals are presented in Appendix 8.13: Other Mammals (Application Document 6.3). A summary of the key plant and habitat features present within the ZoI to the south of the River Thames is provided below in Table 8.16 below.

Table 8.16 Summary of baseline ecological conditions and importance for ecological features south of the River Thames

Biodiversity feature	Importance	Summary description and rationale	Appendix	Tables/ figures
Lower plants	Local	Some notable lichens associated with ancient woodland habitats present. Common and widespread species also present that could enrich the habitat resource through migration, dispersal, and genetic exchange.	8.2	Table 8.10; Figures 8.4 –8.6
Terrestrial invertebrates	National	Two of the survey areas found to support Nationally Rare and Scare invertebrate species. Other areas identified species of local and regional ecological importance.	8.3	Table 8.11; Figure 8.7
Freshwater species – macro-invertebrates	County	The Thames Estuary and Marshes Ramsar site is known to support freshwater invertebrate species of conservation interest. Surveys indicate high macro-invertebrate diversity, including seven macro-invertebrates of ecological importance such as *Hydrochus ignicollis* and *Stratiomys longicornis*.	8.4	Table 8.12, Table 8.13
Freshwater species – macrophytes	County	Macrophyte surveys were undertaken at Filborough Marshes. The sharp rush was reported. Some ditches had New Zealand pigmyweed and water fern. However, sites demonstrated high overall macrophyte cover	8.4	N/A
Amphibians – GCN	County	34 ponds had GCN presence confirmed/assumed. Four meta-populations were identified within the GCN study area.	8.5	Table 8.14; Figure 8.8
Amphibians – common toad	Local	Common toad were recorded on four occasions during GCN surveys and 11 desk-study records were found. Habitat is potentially suitable for breeding.	8.5	N/A

Biodiversity feature	Importance	Summary description and rationale	Appendix	Tables/ figures
Reptiles	County	Low to good populations of three common reptile species were recorded within 10 sites. Habitat potentially suitable for reptiles.	8.6	Figure 8.9
Ornithology – general assemblage	County	Three qualifying species for the designation were recorded. Notable breeding (probable or confirmed) species, 13 noteworthy species and seven waterbird species were recorded. Habitats grouped into two key areas.	8.7	Figures 8.10–8.17; 8.21, 8.22
Ornithology – barn owl	No appreciable importance	Three recordings of barn owls foraging. No evidence of breeding was observed. The population was considered likely to be residing to the north of the River Thames.	8.7	Figures 8.18 & 8.20
Ornithology – marsh harrier	County	One pair of marsh harrier was confirmed foraging and breeding in the marshes and reedbeds adjacent to the south bank of the River Thames.	8.7	Figure 8.21
Bat species and assemblages	County	Bat activity onsite was from common species with the remaining being rarer species. No maternity roosts were identified onsite and the hibernation roosts onsite only contained low numbers of bats.	8.8	Figures 8.23 & 8.25
Bat roosts	County	Eight confirmed bat roosts were identified in total. Five of these were structures, two were trees and one was an old quarry site. Additionally 67 high roost potential trees and 128 moderate roost potential trees were identified.	8.8	Figures 8.23 & 8.24
Dormice	County	52 dormouse nests were found within the designated woodland near to the A2 and within the scrub and hedgerow of Southern Valley Golf Course, and they are likely to be present in any suitable habitat within the A2 corridor.	8.9	Figure 8.26
Water voles	Regional	A large population of water vole was found in the ditches and streams within the Thames Estuary and Marshes Ramsar site and the RSPB reserve. This population is thought to represent a significant proportion of the regional population.	8.10	Figures 8.27 & 8.28
Otters	Local	A single potential otter spraint was located south of the River Thames It is considered unlikely that they are present in the study area.	8.11	Figure 8.27

Biodiversity feature	Importance	Summary description and rationale	Appendix	Tables/ figures
Badgers	Local	There were nine main setts identified, eight of which were within the woodlands of the A2 corridor. A further 105 non-main setts were also identified. Although protected, badger and their setts are not considered a species of conservation concern.	8.12	Figures 8.29 & 8.30
Other notable mammals	No appreciable importance	None of the considered mammals (brown hare, harvest mouse and hedgehog) were recorded from surveys or incidental sightings. Given likely small populations, none are considered further in this assessment.	8.13	Figure 8.31

River Thames

8.4.74 The study area of the River Thames section of the Project is confined to the area below mean high water springs (MHWS). The majority of the ecological features that are associated with this area are addressed in Chapter 9: Marine Biodiversity. Those that are relevant to terrestrial biodiversity are outlined below, which includes designated sites, ornithology and otters.

Statutory designated sites

8.4.75 There are two statutory designated sites of international importance that are associated with the River Thames study area: the Thames Estuary and Marshes SPA, and Ramsar site. The boundaries of these sites are shown on Figure 8.1 (Application Document 6.2) with the reasons for their designations outlined in Table 8.17. Further details are provided in Table 1.1 of Appendix 8.1: Designated Sites (Application Document 6.3).

8.4.76 The majority of the habitats and other ecological features that are associated with these designated sites are located within the terrestrial areas either side of the southern and northern shorelines of the River Thames. For ease of reporting and to avoid unnecessary repetition, these sites are nonetheless discussed under the 'River Thames' sections of this report. However, the individual ecological features that are associated with these terrestrial areas are discussed under the 'South of the River Thames' and 'North of the River Thames' sections of this report, as relevant, and are not repeated here. Those aquatic features that are associated with the intertidal areas between the shorelines are discussed in Chapter 9: Marine Biodiversity.

Table 8.17 Statutory designated sites within the River Thames study area

Designated site	Interest features, citation lists and reasons for designation	Level of importance	Approximate distance from Order Limits
Thames Estuary and Marshes SPA	• Overwintering birds, including hen harrier, avocet, dunlin *Calidris alpina*, knot, black-tailed godwit, grey plover *Pluvialis squatarola*, redshank and short-eared owl	International	59m

Designated site	Interest features, citation lists and reasons for designation	Level of importance	Approximate distance from Order Limits
	• Birds on passage, including ringed plover *Charadrius hiaticula* • Overwintering waterfowl assemblage		
Thames Estuary and Marshes Ramsar site	• Estuarine habitats including saltmarsh, grazing marsh, floodplain grazing marsh, ditches, and saline lagoons • Endangered and Nationally Scarce wetland plant species • Invertebrates • Overwintering and on-passage bird species and assemblage of overwintering birds	International	0m (within Order Limits)

Non-statutory designated sites

8.4.77 No non-statutory designated sites are located within the River Thames study area. Those that are associated with the marshes of the river are outlined within the south of the River Thames and north of the River Thames sections of this report.

Ornithology

8.4.78 Both of the designated sites listed above in Table 8.17 are designated, in part, for their ornithology interests.

8.4.79 For all calculations of the SPA percentage, populations listed below have been calculated using the most recent full WeBS data (20011/12–2015/16) as the SPA citation data is pre-2000, and there have been significant population changes with the species designated in this period of time. For full details, please refer to Appendix 8.7: Ornithology (Application Document 6.3).

8.4.80 The main areas of importance for birds using the intertidal areas within the study area was around the mudflats and saltmarsh south and south-east of Coalhouse Fort, on the northern shore of the River Thames. This area was identified as having a large high tide roost of non-breeding birds. The mudflats around Coalhouse Fort were found to have peak counts of:

a. 830 avocet (42.4% of the SPA population)

b. 1,298 black-tailed godwit (24.8% of the SPA population)

c. 1,109 dunlin (8.3% of the SPA population)

d. 55 grey plover (4.16% of the SPA population)

e. 21 knot (0.7% of the SPA population)

f. 38 redshank (5.9% of the SPA population)

g. 162 ringed plover (49.4% of the SPA population)

8.4.81 The mudflats to the west of the above area and east of the existing jetty were also found to have good numbers of SPA birds, although this area was of much less significance in comparison with Coalhouse Fort. This area supported:

a. 14 avocet (0.7% of the SPA population)

b. 246 black-tailed godwit (4.7% of the SPA population)

c. 420 dunlin (3.2% of the SPA population)

d. Two grey plover (0.2% of the SPA population)

e. 18 redshank (2.8% of the SPA population)

f. 25 ringed plover (7.6% of the SPA population)

8.4.82 On the southern shore of the River Thames, the mudflats around Shornemead Fort had some good numbers of SPA birds, although mostly lower in comparison with the northern shore. Here there were peak records of:

a. 20 avocet (1% of the SPA population)

b. 130 black-tailed godwit (2.5% of the SPA population)

c. 200 dunlin (1.5% of the SPA population)

d. 32 grey plover (2.4% of the SPA population)

e. 80 redshank (12.5% of the SPA population)

f. 45 ringed plover (13.7% of the SPA population)

8.4.83 The bird populations using the mudflats and saltmarsh around Coalhouse Fort, Tilbury Power Station and Shornemead Fort are considered to be of national importance, representing critical parts of the wider national population whilst also forming significant proportions of the populations of the designated sites.

8.4.84 The mudflats to the north of the Metropolitan Police firing range held no significant aggregations of birds.

8.4.85 The River Thames was also used by small numbers of raptors and owls for the purposes of commuting and hunting. Marsh harrier and barn owl were observed crossing, the latter carrying food. Peregrines were observed commuting along the shore and hunting wildfowl. The populations of raptors and owls that were recorded using the River Thames are associated with the habitats to the south and north of the foreshore and are therefore addressed within those respective geographical subsections of this report.

8.4.86 Further details regarding the ornithological baseline conditions are presented in Appendix 8.7: Ornithology (Application Document 6.3).

Otters

8.4.87 The River Thames was not surveyed for the presence of otter due to the constraints associated with the tidal nature of the river. The habitat is

considered suitable for otter, and with otter signs located in watercourses both adjacent to the River Thames, and in watercourses that flow into the River Thames, the otter population within the study area here is likely to represent a critical part of the local population and is therefore considered to be of local importance. Further details regarding the otter baseline conditions are presented in Appendix 8.11: Otter (Application Document 6.3).

8.4.88 A summary of the key features present within the River Thames is provided in Table 8.18.

Table 8.18 Summary of baseline ecological conditions and importance for the ecological features within the River Thames

Biodiversity feature	Summary description and rationale	Importance	Appendix	Tables/ Figures
Ornithology	The mudflats and saltmarsh south-east of Coalhouse Fort, on the north shore of the River Thames, were identified as having a large high tide roost of non-breeding birds. The mudflats to the east of the existing jetty and the mudflats around Shornemead Fort on the south shore of the river were also found to have good numbers of SPA birds, though numbers on the south side were mostly lower in comparison. The mudflats to the north of the Metropolitan Police firing range held no significant aggregations of birds.	National	8.7	Figures 8.10–8.22
Otters	The River Thames was not surveyed for otter presence, but the habitat is considered suitable for otter and otter signs were present in watercourses adjacent to the River Thames.	Local	8.11	N/A

North of the River Thames

Statutory designated sites

8.4.89 There are five statutory designated sites of national importance and four designated sites of county level importance for biodiversity across the study area to the north of the River Thames. These are presented on Figure 8.1: Designated Sites (Application Document 6.2) and outlined in Table 8.19. Further details regarding their reasons for designation and condition assessments are provided in Table 1.1 of Appendix 8.1: Designated Sites (Application Document 6.3).

8.4.90 In line with the baseline information south of the River Thames, an air quality assessment has been undertaken in accordance with DMRB LA 105 standards, which assessed the impacts of the Project from construction dust and nitrogen deposition on designated sites within 200m of any construction works, including haul routes, compound areas and soil storage areas to determine whether it results in a likely significant effect. Additional sites were assessed in relation to air quality where there were likely operational impacts from changes in air

quality within 200m of the ARN. Further details of which sites have been considered in relation to the ARN, and which sites were screened in for further assessment can also be found in Appendix 8.1: Designated Sites (Application Document 6.3) and Appendix 8.14: Designated Sites Air Quality Assessment (Application Document 6.3). These additional sites are excluded from Table 8.19 and Table 8.20 below.

Table 8.19 Statutory designated sites within the study area north of the River Thames

Designated site	Interest features, citation lists and reasons for designation	Level of importance	Approximate distance from Order Limits
Mucking Flats and Marshes SSSI	Mudflats, saltmarsh and grassland supporting important populations of wintering wildfowl and waders and invertebrates.	National	Adjacent to Order Limits
Hangman's Wood & Deneholes SSSI and ASNW	Ancient semi-natural woodland; Medieval chalk mines which provide the most important known underground hibernation site for bats in Essex.	National	307m
Grays Thurrock Chalk Pit SSSI	Former chalk quarry with woodland, scrub, grassland and open water supporting rare plants and invertebrates.	National	1,011m
Grove House Wood LNR	Open and running water, reedbed and woodland.	County	1,351m
Linford Wood LNR	Woodland consisting of a hedgebank, mixed woodland willow plantation and open areas providing important habitat for birds.	County	107m
Cranham Marsh LNR	Marshland, sedge fen and ancient woodland. This site has been identified as containing Groundwater Dependent Terrestrial Ecosystem (GWDTE) habitats (see Section 14.4 of Chapter 14: Road Drainage and the Water Environment).	National	260m
Cranham Brickfields LNR	Former brickfield with large areas of grassland and scrub supporting rare plants, reptiles, invertebrates and GCN.	County	226m
Thorndon Park SSSI	Ancient woodland, parkland, acidic dwarf-shrub heath supporting an outstanding invertebrate assemblage.	National	1,640m
The Manor LNR	Grassland, woodland, hedgerow, ponds and lakes supporting a range of protected and notable species.	County	1,138m

Non-statutory designated sites

8.4.91 A total of 63 non-statutory designated sites are located within the study area to the north of the River Thames, which are presented on Figure 8.1 and Figure 5.3 (Application Document 6.2). A list of sites with a description of each is found in Table 8.20. This includes 56 sites that are located within 500m of the Order Limits. Additionally, seven sites that are located beyond 500m are included as these are likely to be hydrologically linked to the Order Limits and so are

considered on a precautionary basis. Further detail of these sites is provided within Appendix 8.1: Designated Sites (Application Document 6.3).

Table 8.20 Non-statutory designated sites within the study area north of the River Thames

Designated site	Interest features, citation lists and reasons for designation	Level of importance	Approximate distance from Order Limits
Tilbury Marshes LWS	Relic grazing marsh, saltmarsh, brackish ditches and the grassland of Tilbury Fort. Also noted as being of importance for its invertebrate assemblage.	County	0m (within Order Limits)
Goshems Farm LWS	Old landfill area supporting important populations of plants and terrestrial invertebrates. During the production of this report, much of the LWS was subject to ongoing habitat loss as part of a consented planning application by Ingrebourne Valley Ltd (IVL) (D.K. Symes Associates, 2017). At the time of writing, 85% of the LWS has been worked, with only the IVL mitigation area measuring 12ha being retained.	County	0m (within Order Limits)
Tilbury Centre LWS	Mosaic of grassland, ditches, a reed bed and a pond supporting important populations of plants and terrestrial invertebrates.	County	0m (within Order Limits)
Lytag Brownfield LWS	Four reptile species, a developing acid grassland and an important invertebrate community.	County	0m (within Order Limits)
Low Street Pit LWS	Underlain by gravels supporting Thames Terrace Grassland, significant numbers of Essex Red Data List (ERDL) vascular plants and a diverse invertebrate fauna including the national BAP species hornet robberfly *Asilus crabroniformis.*	County	0m (within Order Limits)
Broom Hill LWS	Ancient acid grassland flora and diverse invertebrate community.	County	135m
West Tilbury Hall LWS	River terrace with acidic grassland and a diverse invertebrate fauna.	County	5m
West Tilbury Church LWS	Ancient grassland and botanical interest.	County	120m
Terrel's Heath LWS and Chadwell ASNW	Includes ancient woodland known locally as Chadwell Wood.	National	18m

Designated site	Interest features, citation lists and reasons for designation	Level of importance	Approximate distance from Order Limits
Rainbow Shaw LWS	Small ancient woodland fragment. Although not listed on the Ancient Woodland Inventory, species composition obtained during further detailed botanical surveys have suggested this woodland is likely to qualify as an ancient woodland, and is therefore valued as such within this assessment.	National	0m (within Order Limits)
Millard's Gardens/ Brannett's Wood LWS	Site description includes reference to ancient woodland. Although this site is not listed on the Ancient Woodland Inventory, it has been valued in line with the presence of ancient woodland.	National	1,641m (Hydrological link to Order Limits)
Mardyke LWS	Grassland and reptiles.	County	373m
Brickbarn Wood and Coombe Wood LWS and Brickbarn Wood ASNW	Ancient woodland and rare plants.	National	1,573m (Hydrological link to Order Limits)
Cat's Mede LWS and Sheepfold Wood ASNW	Ancient woodland.	National	0m (immediately adjacent to Order Limits)
Blackshots Nature Area LWS	Rough grassland supporting an important invertebrate population and nesting habitat for ground-nesting birds such as skylark.	County	0m (within Order Limits)
Mucking Heath LWS	Ancient heathlands, acid grassland and invertebrate fauna of interest.	County	0m (within Order Limits)
Orsett Camp Quarry LWS	Grassland, rare plants and invertebrates.	County	3m
Linford Pit LWS	Brownfield site supporting important invertebrate fauna.	County	0m (within Order Limits)
Linford Wood LWS	Comprises a mix of scrub, woodland and plantation. Also comprises part of LNR.	County	106m
Gobions Lake LWS	Mosaic of habitats including willow scrub, reed beds and water bodies.	County	312m
Buckingham Hill LWS	Selected in recognition of the large extent of unimproved acid grassland that is developing here and a significant population of ERDL plant, clustered clover *Trifolium glomeratum*.	County	11m

Designated site	Interest features, citation lists and reasons for designation	Level of importance	Approximate distance from Order Limits
Palmers Shaw LWS and Great Palmers Shaw ASNW	Ancient woodland and lowland mixed deciduous woodland on non-ancient site.	National	476m
Belhus Park East LWS	Hotspot for amphibian diversity and other neutral grassland.	County	1,023m (Hydrological link to Order Limits)
Oak Wood LWS and ASNW	Ancient woodland.	National	1,004m (Hydrological link to Order Limits)
Whitehall Wood ASNW	Ancient woodland.	National	1,098m (Hydrological link to Order Limits)
Brickkiln Wood ASNW/Belhus Woods Country Park LWS	Ancient woodland and soft shield-fern *Polystichum setiferum*, which is an ERDL plant that has declined dramatically in recent years.	National	1,230m (Hydrological link to Order Limits)
Belhus Lakes/ Belhus Wood Country Park LWS	Wet woodland and breeding birds including little ringed plover *Charadrius dubius.*	County	465m
Warwick Wood ASNW	Ancient woodland.	National	1,974m (Hydrological link to Order Limits)
West of Arisdale Avenue LWS	Brownfield site supporting significant populations of ERDL invertebrate species and breeding assemblages of invertebrates with rough, weedy and flower-rich grassland and a small reed-filled hollow.	County	9m
St Nicholas Church LWS	Grassland.	County	325m
Stubber's Outdoor Pursuits Centre SINC	Acid grassland supporting locally scarce plant species, breeding skylarks and meadow pipits, secondary woodland and veteran trees. Open water areas supporting wintering wildfowl, dragonflies and potentially amphibians. Large and important bat roost and important bat foraging area in this part of the borough.	County	0m (within Order Limits)

Designated site	Interest features, citation lists and reasons for designation	Level of importance	Approximate distance from Order Limits
Ockendon Railsides SINC	Network of valuable undisturbed habitat acting as corridors to facilitate the movement of wildlife, consisting of ancient woodland, scrub, rough grassland and secondary woodland.	National	0m (within Order Limits)
Fields South o Cranham Marsh SINC	A series of arable fields, hedges and drains containing rare arable weeds, possibly supporting invertebrate populations and water vole.	County	0m (within Order Limits)
North Ockendon Pit SINC	Neutral grassland and secondary woodland providing habitat for a variety of birds. This site has been identified as containing GWDTE habitats (see Section 14.4 of Chapter 14: Road Drainage and the Water Environment).	County	0m (within Order Limits)
Thames Chase Forest Centre SINC	A demonstration project for the Thames Chase Community Forest, with recently planted woodland, old hedges and ponds.	County	0m (within Order Limits)
Cranham Marsh SINC	Marshland, sedge fen and ancient woodland.	National	259m
Hall Farm Moat, Paddock and St Mary Magdalene Churchyard, North Ockendon SINC	Water bodies forming part of an old moat and species-rich grassland supporting locally rare plant species. Old grotto and church are potential bat roosts.	County	0m (immediately adjacent to Order Limits)
Fairplay Farm SINC	A farm with fine old hedges, supporting traditional farmland birds and mammals, around fields with rare arable weeds.	County	69m
Cranham Hall Shaws and Pasture SINC	Mosaic of habitats with botanical interest, of value to a variety of birds and invertebrates, possibly amphibians.	County	386m
Puddle Dock Angling Centre SINC	Grassland, hedgerows and open water areas of potential interest for nesting birds, bats and invertebrates. Area may support water voles.	County	0m (within Order Limits)
Clay Tye Wood SINC and ASNW	Possible ancient woodland, the only natural habitat within Greater London that supports nesting rooks *Corvus frugilegus*.	National	238m
Franks Wood ASNW	Ancient semi-natural woodland dominated by hornbeam *Carpinus betulus* coppice.	National	0m (immediately adjacent to Order Limits)
Franks Wood and Cranham Brickfields SINC	Ancient woodland and areas of unmanaged grassland.	National	0m (within Order Limits)

Designated site	Interest features, citation lists and reasons for designation	Level of importance	Approximate distance from Order Limits
Hobbs Hole Wood LWS and ASNW	Ancient woodland and lowland mixed deciduous woodland.	National	0m (within Order Limits)
Pot Kiln Wood and Sickle Wood SINC	Pot Kiln Wood is a mosaic of scrub and grassland providing habitat for nesting birds. Sickle Wood is an area of scrub with a partial woodland canopy providing suitable habitat for foraging and breeding birds and a variety of invertebrates.	County	117m
Codham Hall Wood LWS and ASNW	Ancient woodland dominated by hornbeam coppice.	National	0m (within Order Limits)
Ancient woodland west of M25 junction 29 and Codham Hall Wood West SINC	Ancient woodland.	National	0m (within Order Limits)
Warley Hall Wood LWS and ASNW	Ancient woodland.	National	345m
Hillview SINC	Ancient woodland and neutral grassland.	National	105m
Woodlands School LWS	Dry and wet grassland.	County	219m
Jackson's Wood/Tylers Shaw LWS and ASNW	Ancient woodland.	National	21m
Tomkyns East Pastures SINC	Species-rich grassland likely supporting a diverse invertebrate community, ancient hedge and treelines.	County	166m
Tylers Common SINC	A large common with a good range of wildlife habitats with some uncommon plants.	County	274m
Tylers Wood SINC	Lowland deciduous woodland and neutral grassland.	County	0m (within Order Limits)
Folkes Lane Woodland SINC	Lowland deciduous woodland and neutral grassland.	County	0m (within Order Limits)
Folkes Lane Wood ASNW	Ancient semi-natural woodland.	National	2m
Coombe Wood LWS, Foxburrow Wood SINC and Coombegreen Wood ASNW	Ancient semi-natural woodland, lowland mixed deciduous woodland on non-ancient site.	National	0m (within Order Limits)

Designated site	Interest features, citation lists and reasons for designation	Level of importance	Approximate distance from Order Limits
Jermains Wood SINC	Ancient woodland providing habitat for invertebrates and breeding birds.	National	0m (immediately adjacent to Order Limits)
Tylers Hall Pond SINC	Large pond with a range of aquatic vegetation.	County	441m
Ingrebourne Valley SINC	Important wetlands at the lower end and ancient alder woods further upstream.	County	286m
Parker's Shaw LWS	Lowland deciduous woodland.	County	0m (within Order Limits)
Holden's Wood LWS	A large woodland with associated understory.	County	385m
Warley Place LWS	Woodland reserve on the site of an old garden.	County	345m
The Wilderness ASNW	Ancient woodland	National	0m (within Order Limits)

Plants and habitats

8.4.92 A full description of the plants and habitats baseline conditions is presented in Appendix 8.2: Plants and Habitats (Application Document 6.3). A summary of the key plant and habitat features present within the ZoI to the north of the River Thames is provided below in Table 8.21.

Table 8.21 Summary evaluation of plants and habitats to the north of the River Thames

Habitat/ species	Level of importance	Justification
Ancient woodland	National	• Ancient woodland is an irreplaceable habitat and therefore meets the DMRB (Highways England, 2020a) criteria for being of national importance, as outlined in Table 8.5. • The habitat is also listed as a 'lowland mixed deciduous woodland' HoPI in line with the requirements of section 41 of the NERC Act 2006. • Ancient woodland sites are also included as priority habitat on the Essex BAP.
Ancient and veteran trees	National	• Ancient and veteran trees are an irreplaceable habitat and therefore meet the DMRB (Highways England, 2020a) criteria for being of national importance, as outlined in Table 8.5.
Semi-natural broadleaved woodland	County	• This habitat is included as a 'lowland mixed deciduous woodland' HoPI in line with the requirements of section 41 of the NERC Act 2006 However, this habitat is common and widespread throughout the ZoI and the wider landscape and is therefore not considered of national importance. • It is likely to appreciably enrich the habitat resource at a county level and provide habitat features that are of importance for migration, dispersal and genetic exchange of species.
Plantation woodland	Local	• Widespread and common within the ZoI, and are structurally poor with limited species diversity. • Not specifically included within any county-level plans or strategies relevant to Essex. • This habitat is likely to appreciably enrich the habitat resource within the local context, supporting species and features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.
Scrub	Local	• This habitat is common and widespread throughout the ZoI and surrounding landscape. • Contains singular records of notable species black poplar *Populus nigra subsp. Betulifolia* and chicory. • Not specifically included within any county-level plans or strategies relevant to Essex. • This habitat is likely to appreciably enrich the habitat resource within the local context, supporting species and features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.
Scattered and parkland trees	Local	• Scattered trees are common and widespread throughout the ZoI and surrounding landscape.

Habitat/ species	Level of importance	Justification
(not considered veteran)		• This habitat is likely to appreciably enrich the habitat resource within the local context, supporting species and features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.
Acid grassland	County	• This habitat is listed as 'lowland dry acid grassland' HoPI in line with the requirements of section 41 of the NERC Act 2006. • Although a priority habitat, only a small area is present within the ZoI (0.61ha of unimproved acid grassland and 1.73ha of semi-improved acid grassland). • Contains notable plant species field scabious *Knautia arvensis*, heath speedwell *Veronica officinalis*, shepherd's cress *Teesdalia nudicaulis* and smooth cat's-ear *Hypochaeris glabra*. • This habitat is likely to appreciably enrich the habitat resource at a county level and provide habitat features that are of importance for migration, dispersal and genetic exchange of species and therefore meets the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5.
Neutral grassland	County	• This habitat is common and widespread throughout the ZoI and the surrounding landscape. • It is likely to appreciably enrich the habitat resource at a county level and provide habitat features that are of importance for migration, dispersal and genetic exchange of species and therefore meets the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5.
Improved grassland	Local	• This habitat is common and widespread throughout the ZoI and the surrounding landscape. • It is structurally poor, heavily modified and supports a low species diversity. • This habitat is likely to appreciably enrich the habitat resource within the local context, supporting species and features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.
Marshy grassland	Local	• Very small area present (0.34ha) with poor species assemblage. • Although it is species-poor, this habitat is likely to appreciably enrich the habitat resource within the local context, supporting species and features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.
Species-poor semi-improved grassland	Local	• Common and widespread throughout the ZoI and the surrounding landscape. • Contains one record of notable plant species chicory.

Habitat/ species	Level of importance	Justification
		• This habitat is likely to appreciably enrich the habitat resource within the local context, supporting species and features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.
Tall ruderal vegetation	Local	• Common and widespread throughout the ZoI and the surrounding landscape. • One area contains notable species lesser spearwort and sea stock *Matthiola sinuata*. • This habitat is likely to appreciably enrich the habitat resource within the local context, supporting species and features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.
Non-ruderal herbs	No appreciable importance	• Common and widespread throughout the ZoI and the surrounding landscape. • Small areas (0.15ha in total). • This habitat is not likely to appreciably enrich the habitat resource within the local context or support species and features of importance for migration, dispersal, or genetic exchange.
Swamp and marginal vegetation	County	• Reedbed is included as a priority habitat on the Essex BAP, but this area is not considered to qualify as a HoPI as the habitat is not both dominated by common reed and water logged for most of the year. As a result is it considered that it meets the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5. • Contains notable plant species divided sedge *Carex divisa.*
	Local	• The remaining areas of swamp comprised small areas of habitat which are common and widespread throughout the ZoI and the surrounding landscape. • Although small, this habitat is likely to appreciably enrich the habitat resource within the local context, supporting species and features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.
Standing water (ponds)	County	• Ponds are listed as HoPI in line with the requirements of section 41 of the NERC Act 2006. However, this habitat is common and widespread throughout the study area and the wider landscape and is therefore not considered of national importance. • Ponds are likely to appreciably enrich the habitat resource at a county level and provide habitat features that are of importance for migration, dispersal and genetic exchange of species and therefore meet the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5.

Habitat/ species	Level of importance	Justification
Standing water (lakes and reservoirs)	Local	• Common and widespread throughout the ZoI and wider landscape. • Habitat is likely to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.
Standing water (ditches)	Local	• Common and widespread throughout the ZoI and wider landscape. • Habitat is likely to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.
Running water	County	• Rivers and streams are likely to appreciably enrich the habitat resource at a county level and provide habitat features that are of importance for migration, dispersal and genetic exchange of species and therefore meet the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5.
Coastal	National	• Coastal saltmarsh, coastal vegetated shingle, and intertidal mudflats are listed as HoPIs in line with the requirements of section 41 of the NERC Act 2006. • Coastal habitats are likely to appreciably enrich the habitat resource at a county level and provide habitat features that are of importance for migration, dispersal and genetic exchange of species and therefore meet the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5.
Arable	Local	• This habitat is common and widespread throughout the ZoI and surrounding landscape. • Contains notable species purple ramping-fumitory *Fumaria purpurea*. • Habitat is likely to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.
Amenity grassland	No appreciable importance	• Common and widespread habitat of low species diversity and poor structural integrity. • This habitat is not considered to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange.
Ephemeral/short perennial	Local	• Contains the notable species purple ramping-fumitory. • This habitat is likely to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange and therefore meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.

Habitat/ species	Level of importance	Justification
Hedgerows (species rich)	County	• Hedgerows are listed as HoPI in line with the requirements of section 41 of the NERC Act 2006, However, this habitat is common and widespread throughout the study area and the wider landscape and is therefore not considered of national importance. • Ancient and/or species-rich hedgerows are included as a priority habitat on the Essex BAP. Therefore this habitat meets the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5.
Hedgerows (species poor)	Local	• Structurally poor with limited species diversity. • Species-poor hedgerows are likely to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange; therefore this habitat meets the DMRB (Highways England, 2020a) criteria for being of local importance, as outlined in Table 8.5.
Hedgerows (nonnative)	No appreciable importance	• Species-poor and comprising non-native species only. • This habitat is not considered to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange.
Open mosaic habitats	National	• Open mosaic habitats on previously developed land and listed as HoPI in line with the requirements of section 41 of the NERC Act 2006 and therefore this habitat meets the DMRB (Highways England, 2020a) criteria for being of national importance, as outlined in Table 8.5. • Contains notable species annual beard-grass *Polypogon monspeliensis* and dittander *Lepidium latifolium*.
Other habitats including bare ground and buildings	No appreciable importance	• These habitats are common and widespread throughout the ZoI and surrounding landscape and do not appreciably enrich the habitat resource within the local context. • Unlikely to support features of importance for migration, dispersal, or genetic exchange of species.
Lichen assemblage	County	• Lichen assemblage at Low Street Pit LWS, Mucking Heath LWS, the Wilderness Woodland and the woodland around junction 29 of the M25. • One patch of terricolous lichens was found at Low Street Pit LWS including the species *Cladonia ubbute* and *C. chlorphaea*, both of which are in decline in Essex. • Terricolous lichen flora found at Mucking Heath LWS is of interest because heathland lichens are in sharp decline in Essex and the London area.

Habitat/ species	Level of importance	Justification
		• Notable species *Physconia distorta* and *Fellhaneropsis vezdae* within the Wilderness and bearded lichen *Usnea cf. esperantiana* within the ancient woodland to the south-west of junction 29 of the M25; these are uncommon in Essex. • The loss of these populations would adversely affect the conservation status or distribution of the species at a county scale and therefore the lichen assemblage meets the DMRB (Highways England, 2020a) criteria for being of county importance, as outlined in Table 8.5.
Bryophyte assemblage present throughout study area	No appreciable importance	• The bryophyte flora was typical for Essex woodland and the species recorded were common and widespread. • The species populations or communities are not considered likely to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange.
Invasive Non-Native Species (INNS)	No appreciable importance to biodiversity	• Included on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended). • Included on Schedule 2 of the Invasive Alien Species (Enforcement and Permitting) Order 2019. • Areas of habitat, species populations or communities are not considered likely to appreciably enrich the habitat resource within the local context including features of importance for migration, dispersal, or genetic exchange. • INNS are likely to have an adverse effect on biodiversity by reducing the composition and diversity of native species and habitats.

Terrestrial invertebrates

8.4.93 A full description of the terrestrial invertebrates baseline conditions is presented in Appendix 8.3: Terrestrial Invertebrates (Application Document 6.3).

8.4.94 Within the study area to the north of the River Thames, 10 invertebrate survey areas (Survey Areas 3, 4, 5, 6, 7, 8, 9, 10, 11 and 13 (refer to Figure 8.7 (Application Document 6.2)) were identified as sites suitable for supporting invertebrate assemblages of notable conservation value, and so worthy of consideration within this assessment. Survey Area 10 was subsequently divided into two sub-areas: 10a and 10b. Aquatic invertebrate surveys were also carried out in Survey Area 13.

8.4.95 Survey Areas 5 (Lytag Brownfield) and 6 (Tilbury Fort) have been previously subject to extensive invertebrate surveys (as part of the Tilbury2 assessment). The results of these surveys were obtained to inform this assessment and so these areas were not subjected to field surveys as part of the Project. No surveys were undertaken in Survey Area 9 due to land access restrictions. However, based on desk-study data (including the presence of designated sites within the survey area) and viewing Phase 1/aerial maps, an indicative assessment of this area was made, using professional judgement to assume a reasonable worst-case scenario.

8.4.96 Invertebrate assemblages associated with open, early successional habitats were extremely well represented throughout many of the survey areas. Of the survey areas that contain these habitats, five are considered of national importance, two of regional importance and one of county importance, since the loss of the populations within those sites would be likely to adversely affect the conservation status or distribution of the species at those scales (see Table 8.22). These assemblages were supported by remnant patches of Thames Terrace grassland and numerous brownfield sites, which fit the criteria of ‘Open Mosaic Habitat on Previously Developed Land’, which is a habitat of principal importance listed in accordance with the requirements of section 41 of the NERC Act 2006.

8.4.97 The brownfield sites adjacent to the River Thames, in particular, are situated in a corridor that provides connected high-quality habitat at a landscape scale. These sites hosted a particularly diverse invertebrate assemblage including brownfield ‘flagship’ species, such as shrill carder bee, brown-banded carder bee *Bombus humilis* and hornet robberfly, which are species of principal importance, along with one species considered extinct in the UK, a cuckoo wasp *Hedychrum rutilans*.

8.4.98 Woodland invertebrate assemblages were represented within woodland habitat at the Wilderness and Codham Hall Wood. These assemblages were considered of county biodiversity importance since they would only be likely to appreciably enrich the habitat resource in a county context and support species and features of importance for migration, dispersal, or genetic exchange at that scale.

8.4.99 The invertebrate assemblage associated with a 'rich flower resource' was represented throughout many of the survey areas. This is not habitat-specific but indicates the value of the flower resource across multiple habitats. In some survey areas, this invertebrate assemblage was considered of national importance, supporting a critical part of the national population of the species present and reflecting the diversity of bee species recorded in these areas.

8.4.100 As outlined in Table 8.22, Survey Area 3 was considered to be of national importance for terrestrial invertebrates. The entirety of Survey Area 3, with the exception of approximately 12ha of scrub, tall ruderal grassland and wetland habitat within Goshems Farm LWS and an additional 12ha of open mosaic habitat to the west of the Order Limits, has been worked through pulverised fuel ash (PFA) removal and earthworks prior to the commencement of the construction phase of the Project, as part of a consented planning application by IVL (D.K. Symes Associates, 2017). This includes approximately 85% of Goshems Farm LWS. The remaining 15% of the LWS, which falls within Survey Area 3, is to be retained by the IVL scheme. All of this retained habitat falls outside of the Order Limits. This has therefore been accounted for in the baseline conditions for the Project, despite the PFA removal works not being completed at the time when the invertebrate surveys for the Project were conducted (as outlined in Appendix 8.3: Terrestrial Invertebrates (Application Document 6.3)). The suitability of this area to support terrestrial invertebrates will therefore be reduced substantially from those conditions that were observed during the baseline surveys. However, the remaining area of retained habitat is nonetheless representative of those habitats that were surveyed for terrestrial invertebrates. It is therefore, on a precautionary basis, still considered of national importance, since the important 'bare sand & chalk', 'scrub-heath & moorland' and 'rich flower resource' invertebrate assemblages are likely to remain present within this retained area.

8.4.101 The baseline conditions in each invertebrate survey area north of the River Thames are further summarised in Table 8.22.

Table 8.22 Baseline conditions for invertebrate survey areas north of the River Thames

Survey area	Broad description	Associated designated site with invertebrate interest	Recorded species with recognised conservation status*	Supported Pantheon invertebrate assemblages**	Level of importance
Area 3: Goshems Farm	Open mosaic habitat on previously developed land with mix of artificial spoil, PFA, tall ruderal herbs and scrub, moderately species-rich neutral grassland, ephemeral short perennial vegetation, tracks and rides, and numerous ditches.	Goshems Farm LWS	Fifty-five species (out of 372 (14.8%)), including one species previously thought extinct in the UK (*Hedychrum rutilans*), one recently established species in the UK (Rambur's pied shieldbug *ss*), two RDB2, six RDB3, one RDBK, one IUCN Near Threatened, seven section 41 and 37 Nationally Scarce species. Twenty-seven species are Essex RDB listed.	Habitat level 'tall sward & scrub', 'short sward & bare ground', 'arboreal', 'marshland' and 'peatland' invertebrate assemblages were well represented within this area. Specific 'bare sand & chalk', 'scrub-heath & moorland' and 'rich flower resource' invertebrate assemblages of national importance were supported within this area.	National
Area 4: Horse Field	Semi-improved grassland and scrub mosaic on the site of a capped former landfill.	None	Thirty-two species (out of 299 (11%)), including one RDB2, one RDB3, one IUCN Near Threatened, five section 41 and 21 Nationally Scarce species. Thirteen species are Essex RDB listed.	Habitat level 'tall sward & scrub', 'short sward & bare ground', 'arboreal' invertebrate assemblages were significantly represented within this area. Within these assemblages, Area 4 supported specific 'open short sward' and 'rich flower resource' invertebrate assemblages of national importance.	National
Area 5: Lytag Brownfield	Extensive developing acid grassland and open mosaic habitat on previously developed	Lytag Brownfield LWS	Survey Area 5 was surveyed in 2016 and 2017 to inform the Environmental Statement of the neighbouring Tilbury2 development. The results found that this area supported a large		National

Survey area	Broad description	Associated designated site with invertebrate interest	Recorded species with recognised conservation status*	Supported Pantheon invertebrate assemblages**	Level of importance
	land. Abundant potential valuable invertebrate habitat.		number of key species and is considered to be of national importance for invertebrates (Telfer, 2017).		
Area 6: Tilbury Fort	Former coastal grazing marsh, now largely arable land, brackish ditches and grasslands of Tilbury Fort.	Tilbury Marshes LWS	The north half of Survey Area 6 was surveyed in 2016 and 2017 to inform the Environmental Statement of the neighbouring Tilbury2 development. This area supported a number of rare key species and is considered 'probably of national importance of its own right' (Telfer, 2017).		National
Area 7: Low Street Pit	The Low Street Pit section supported Thames Terrace grassland remnants and a mosaic of scrub/woodland/tall ruderal, unimproved acid grassland, and wetland habitat. The European Metal Recycling section includes primarily open mosaic habitat with extensive areas of dense, continuous scrub and tall herb habitat at the margins.	Low Street Pit LWS	Thirty-six species (out of 410 (8.8%)), including one RDB2, five RDB3, two IUCN Near Threatened, four section 41 and 26 Nationally Scarce species. Twenty-two species are Essex RDB listed.	Habitat level 'tall sward & scrub', 'short sward & bare ground', 'arboreal', 'peatland' and 'marshland' invertebrate assemblages were significantly represented within this area. Within these assemblages, Area 7 supported specific 'open short sward', 'scrub-heath & moorland' and 'rich flower resource' invertebrate assemblages of national importance.	National
Area 8: Mucking Heath	The site comprised relict acid grassland in mosaic with deciduous scrub/woodland at margins.	Mucking Heath LWS	Ten species (out of 212 (4.7%)), including one Nationally Rare, one RDB3, four section 41 and one Nationally Scarce species. Five species are Essex RDB listed.	Habitat level 'tall sward & scrub', 'short sward & bare ground' and 'arboreal' invertebrate assemblages were represented within this area. In addition, Area 8 supported a specific 'scrub-heath & moorland' invertebrate assemblage of regional importance.	Regional

Survey area	Broad description	Associated designated site with invertebrate interest	Recorded species with recognised conservation status*	Supported Pantheon invertebrate assemblages**	Level of importance
Area 9: Blackshots Nature Area	A large area of rough grassland interspersed with scattered scrub. To the east was an area of brownfield land containing piles of soil and rubble, now developing with pioneer vegetation and scrub.	Blackshots Nature Area LWS	Blackshots Nature Area LWS is described within the Thurrock Biodiversity Study 2006–2011 as supporting '*an important invertebrate population*' which '*includes seven Essex Red Data List species, as well as the national BAP fly Dorycera graminum*'.		Regional***
Area 10a: North Ockendon (woodland)	The woodland site supported semi-natural broadleaved woodland with two large ponds.	None	Sixteen species (out of 274 (5.8%)), including one section 41 species (white-letter hairstreak *Satyrium w-album*) along with one RDBK, two section 41 and nine Nationally Scarce species. Eight species are Essex RDB listed.	No invertebrate assemblages of national importance were recorded in this area. Habitat level 'arboreal' and 'shaded woodland floor' invertebrate assemblages of some conservation value were present alongside 'tall sward & scrub' and 'peatland' invertebrate assemblages all of which contained species with recognised conservation status.	County
Area 10b: North Ockendon (grassland)	The open habitat comprised a mosaic of rough, semi-improved grassland and tall herb, and scrub habitat on the site of a historic landfill site.	None	Thirteen species (out of 175 (7.4%)), including one RDB3, two RDBK, three section 41 and eight Nationally Scarce species. Six species are Essex RDB listed.	No invertebrate assemblages of national importance were recorded in this area. Habitat level 'short sward & bare ground' and 'tall sward & scrub' invertebrate assemblages of some conservation value were present.	County

Survey area	Broad description	Associated designated site with invertebrate interest	Recorded species with recognised conservation status*	Supported Pantheon invertebrate assemblages**	Level of importance
Area 11: M25 Woodlands	The four woodland sections of Area 11 collectively comprise a significant area of primarily semi-natural broadleaved and ancient woodland around the roundabout at the junction between the M25 and A127.	None	Nineteen species (out of 276 (6.9%)), including two RDB3, one IUCN Near Threatened, two section 41 and 14 Nationally Scarce species. Twelve species are Essex RDB listed.	This area supported a habitat level 'short sward & bare ground' invertebrate assemblage of high conservation value and an 'arboreal' assemblage of moderate conservation value. Also supported were 'shaded woodland floor' and 'tall sward & scrub' habitat level invertebrate assemblages.	County
Area 13: Linford	An area of semi-natural broadleaved woodland and scrub; semi-improved neutral grassland; open mosaic habitat; unvegetated bare ground/active quarry; and standing water.	Linford Pit LWS; Rainbow Shaw LWS	Forty-eight species (out of 513 (9.4%)), including one proposed Nationally Vulnerable; four Nationally Rare (RDB3); four 'Near Threatened'; three RDBK 'unknown' or Data Deficient (DD); 33 Nationally Scarce; two section 41; and 28 listed as one of Essex Red Data Book categories.	Assemblages relating to the open mosaic habitats and herb-rich grassland components of the site supported assemblages of highest conservation value. The wetland habitats surveyed, the open water habitat subject to aquatic sampling, returned rather low scores in terms of conservation value.	National

*** RDB2** (Vulnerable): Pre-1994 classification – Species that are declining throughout their range or occupy vulnerable habitats and are likely to move into the Endangered category.
RDB3 (Rare): Pre-1994 classification – Species which are not currently either Endangered or Vulnerable, are at risk and exist in 15 or fewer 10km squares.
RDBK (Insufficiently Known): Pre-1994 classification – Species suspected to merit either Endangered, Vulnerable, Rare or Indeterminate status but lacking enough information.
IUCN Endangered: Post 1994 IUCN threat guidelines – Species, which the best available evidence indicates, is facing a very high risk of extinction in the wild.
IUCN Near Threatened: Post 1994 IUCN threat guidelines – Species which do not qualify for Endangered or Vulnerable now but are likely to qualify in the near future.
Nationally Scarce: Post 1994 GB rarity status – Species which have been recorded from more than 16 and no more than 100 10km squares in the UK.
Section 41: Species of principal importance, listed on section 41 of the NERC Act 2006.

Essex RDB: Species listed in the Essex Red Data Book as a priority for conservation in Essex.
** Pantheon is a database tool developed by Natural England and the Centre for Ecology & Hydrology to analyse invertebrate sample data. This information can be used to determine site quality by revealing whether the species list is indicative of good quality habitat, inform on species ecology and assist in management decisions by revealing the key ecological resources (Webb *et al.*, 2017).
*** Area not surveyed, and assessment based on desk-study information.

Freshwater species

8.4.102 A full description of the baseline conditions relating to freshwater ecology is presented in Appendix 8.4: Freshwater Ecology (Application Document 6.3).

Macro-invertebrates

8.4.103 A single site designated for its aquatic invertebrate interests is present within the study area to the north of the River Thames: Tilbury Centre LWS.

8.4.104 For the two Mardyke sites, Water Framework Directive (WFD) macro-invertebrate classification metrics were calculated (refer to Appendix 8.4: Freshwater Ecology (Application Document 6.3)). The upstream site was classified as Moderate across the two survey seasons, while the downstream site was classified as Bad in summer and High in autumn.

8.4.105 Generally, the macro-invertebrate communities within the Mardyke were of a low conservation status; with only one species of note recorded: the dragonfly *Libellula fulva*. Table 8.23 below shows the individual Conservation Score (Chadd and Extence, 2004) for the species recorded following the methodology described in Appendix 8.4: Freshwater Ecology (Application Document 6.3).

Table 8.23 Species of conservation interest – Mardyke

Location	Date sampled	Species present	Group	Abundance	Conservation Score	Red Data Book score
Mardyke South	08 November 2018	*Libellula fulva*	Dragonfly	1	Rare	RDB3

8.4.106 Desk studies (Colin Plant Associates, 2008 & 2016; Telfer, 2017) found macro-invertebrate reports which had been commissioned by Bioscan (UK) Ltd to assess macro-invertebrate communities on land adjacent to Tilbury Power Station. These reports found a number of aquatic invertebrates which were Nationally Scarce, mainly aquatic beetles. The report undertaken in 2007 found three RDB species: the soldier fly *Stratiomys longicornis* (RDB2), a diving beetle *Graptodytes bilineatus* (RDB3) and the damselfly *Lestes dryas* (RDB3).

8.4.107 Field studies undertaken in 2018 sampled three ditches near to the proposed North Portal. A further eleven sites were surveyed in spring and summer 2022. These sites recorded a single species of conservation interest (Table 8.24) and, as a result, the Community Conservation Index (CCI) (Chadd and Extence, 2004) classified the community as Very High. Table 8.24 below shows the individual Conservation Score for each species recorded following the methodology described in Appendix 8.4: Freshwater Ecology (Application Document 6.3).

8.4.108 As a result of the similarities across the study sites linked to development of the North Portal, and their likely similar responses to the key predicted impacts such as habitat loss and water quality effects, they have been valued as a single receptor. Many of the species identified across the study sites are known to exist at other locations across the south-east of England and were recorded in low abundances in the samples. As a result, the macroinvertebrate assemblage to the north of the River Thames is considered to be of county importance to biodiversity.

Table 8.24 Species of conservation interest – North Portal

Site	Species	Group	Abundance	Conservation Score	Red Data Book score
W022N	*Berosus affinis*	Coleoptera (beetles)	7	Notable	N/A
W026N	*Enochrus bicolor*	Coleoptera	3	Notable	N/A
	Enochrus halophilus	Coleoptera	2	Notable	N/A
	Hygrotus parallelogrammus	Coleoptera	4	Notable	N/A
	Hygrotus quinquelineatus	Coleoptera	6	Notable	N/A
	Rhantus frontalis	Coleoptera	4	Notable	N/A
W029	*Agabus conspersus*	Coleoptera	1	Notable	N/A
JN1	*Rhantus frontalis*	Coleoptera	1	Notable	N/A
JN3	*Agabus conspersus*	Coleoptera	2	Notable	N/A
	Berosus affinis	Coleoptera	1	Notable	N/A
	Enochrus bicolor	Coleoptera	1	Notable	N/A
	Ochthebius marinus	Coleoptera	1	Notable	N/A
JN10	*Enochrus bicolor*	Coleoptera	10	Notable	N/A

Macrophytes

8.4.109 Macrophytes within the study area to the north of the River Thames were surveyed in July 2022 having been previously screened out due to lack of notable diversity and abundance (See Appendix 8.4: Freshwater Ecology (Application Document 6.3)). Survey of twelve sites confirmed very low diversity and high coverage of macrophytes at all sites and reported no nationally or locally rare species. As a result, the macrophyte assemblage to the north of the River Thames is considered to be of less than local importance to biodiversity.

Fish

8.4.110 Historical fisheries data for the Mardyke were provided by the Environment Agency for surveys completed in 2012 and 2013. Catches were mainly of coarse fish and minor species in low densities. Three of the four sites surveyed reported European eel *Anguilla anguilla*, which are listed on the IUCN Red List as Critically Endangered due to a decline in abundances across all life cycles (Zoological Society of London, 2018). They are also listed in Appendix II of the Convention on Migratory Species (2018) and are provided with protection measures under the Eels (England and Wales) Regulations 2009.

8.4.111 No fish surveys have been undertaken in the Tilbury Main ditch network due to inaccessibility of the watercourses. However, it is likely that due to the connectivity of the network to the River Thames via the tidal sluices, eel would be present within the system.

8.4.112 The population of coarse fish within the study area the north of the River Thames is unlikely to represent a critical part of the county or wider population and the loss of this population would not be likely to adversely affect the conservation status or distribution of these species at a county or greater scale. Coarse fish are therefore considered to be of local importance to biodiversity. Eel are considered to be of regional importance to biodiversity for the North Portal and the Mardyke.

Amphibians

8.4.113 A full description of the baseline conditions relating to amphibians is presented in Appendix 8.5: Amphibians (Application Document 6.3) and on Figure 8.8 (Application Document 6.2). A summary of the key amphibians features present within the study area to the north of the River Thames is provided below.

Great crested newt

8.4.114 The desk study returned 302 recent records for GCN within 2km of the Order Limits to the north of the River Thames. The closest relates to an area near Brentwood.

8.4.115 Two statutory designated sites are present within the study area where presence of GCN is an interest feature relating to the site's designation. Cranham Brickfields LNR is located 226m from the Order Limits, although the pond supporting GCN is over 500m from the Order Limits. Given the distance, abundance of suitable habitat near to the pond and lack of habitat connectivity between the Order Limits and this pond, GCN associated with the nature reserve population are considered unlikely to be present within the ZoI of the Project.

8.4.116 Cranham Marsh SINC is located 260m to the west of the Order Limits at its closest point, supports GCN (GIGL, 2022). The site appears to support several ponds and wetland areas with the closest located over 500m from the Order Limits. Given the distance, abundance of suitable habitat near to the pond and lack of habitat connectivity between the Order Limits and this pond, GCN associated with the nature reserve population are considered unlikely to be present within the Order Limits.

8.4.117 Four non-statutory designated sites were designated in part for their amphibian interest features: Cranham Hall Shaws and Pasture SINC, Tylers Common SINC, Franks Wood and Cranham Brickfields SINC and Stubber's Outdoor Pursuits Centre SINC. It should be noted that these sites are not designated for GCN, but for their potential for amphibian interest features. Cranham Hall Shaws and Pasture SINC is located 386m from the Order Limits, Tylers Common SINC is 274m from the Order Limits, Franks Wood and Cranham Brickfields SINC is within the Order Limits and Stubber's Outdoor Pursuits Centre SINC is within the Order Limits.

8.4.118 Of the 275 ponds initially identified through desk study and Phase 1 surveys, GCN presence was confirmed/assumed at 41 ponds within the study area to the north of the River Thames (presence has been assumed on a precautionary basis where access to the pond has not been feasible or survey results were inconclusive). Where ponds were close to each other and there was good habitat connectivity and the absence of physical barriers, populations are

considered to constitute the same metapopulation. These are outlined in Table 8.25.

8.4.119 Where population size has been assumed, a full justification has been provided in Appendix 8.5: Amphibians (Application Document 6.3).

Table 8.25 Summary of GCN populations to the north of the River Thames

Population	Population size	Description
N1	Medium	Two woodland copse ponds
N2	Medium (assumed)	Metapopulation of GCN breeding across four ponds
N3	Medium (assumed)	Single pond, eDNA only
N4	Medium	Metapopulation of GCN breeding across three ponds, eDNA and incidental sightings only
N5	Small	Metapopulation of GCN breeding across two ponds
N6	Medium (assumed)	Metapopulation of GCN breeding across two ponds, eDNA only
N7	Large (assumed)	Metapopulation of GCN breeding across seven ponds, conventional surveys and eDNA
N8	Medium (assumed)	Metapopulation of GCN breeding across three ponds, eDNA surveys only
N9	Medium (assumed)	Metapopulation of GCN breeding across three ponds, eDNA surveys only
N10	Large	Metapopulation of GCN breeding across two ponds
N11/N12	Medium	Metapopulation of GCN breeding across four ponds
N13	Large (assumed)	Metapopulation of GCN breeding across three ponds
N14	Medium (assumed)	Metapopulation of GCN breeding across two ponds
N15	Small	Single woodland pond
N16	Medium (assumed)	Metapopulation of GCN breeding across two ponds

8.4.120 The habitats within the GCN study area to the north of the River Thames support ancient semi-natural broadleaved woodland, neutral grassland, marshy grassland and hedgerows. These provide potentially suitable terrestrial habitat for GCN.

8.4.121 Given the findings of the field surveys within the study area, the desk-study results indicating an extensive distribution of GCN in the wider landscape, and the conservation status of GCN, the populations of GCN to the north of the River Thames within the ZoI are considered to be of county importance for biodiversity. Furthermore, the GCN population within the study area is likely to form a critical part of the wider Essex population, being important for genetic exchange at this scale. The loss of it would therefore be likely to adversely affect the conservation status and distribution of GCN at a county scale.

Common toad

8.4.122 The desk study returned 41 recent records for common toad within 2km of the Order Limits to the north of the River Thames.

8.4.123 Four non-statutory designated sites were designated in part for their amphibian interest features: Cranham Hall Shaws and Pasture SINC, Tylers Common SINC, Franks Wood and Cranham Brickfields SINC and Stubber's Outdoor Pursuits Centre SINC . It should be noted that these sites are not designated for common toad, but for their potential for amphibian interest features. Cranham Hall Shaws and Pasture SINC is located 386m from the Order Limits, Tylers Common SINC is 274m from the Order Limits, Franks Wood and Cranham Brickfields SINC is within the Order Limits and Stubber's Outdoor Pursuits Centre SINC is within the Order Limits .

8.4.124 All standing water, including the ponds identified during the GCN surveys, are considered potentially suitable breeding habitat for common toad. Habitats within the Order Limits to the north of the river comprise mainly arable grassland and improved pasture, which are considered of limited importance for common toad. The mature hedgerows, rough and marshy grassland, scrub and woodland all provide potentially suitable terrestrial habitat for foraging, hibernation and dispersal.

8.4.125 Common toad was recorded at one pond within the study area during targeted GCN surveys and one was seen in a pile of dead wood within the Wilderness Woodland during the terrestrial invertebrate surveys.

8.4.126 Based on a review of desk-study information, incidental sightings, habitat suitability assessment and conservation status, the likely population of common toad within the ZoI north of the River Thames is considered to be of local importance for biodiversity, since the population within the study area is not likely to form a critical part of the county population, and the loss of this population will not adversely affect the conservation status of the population at a county scale.

Reptiles

8.4.127 One designated site, designated in part for its reptile populations was found within 2km of the Order Limits north of the River Thames: Cranham Brickfields LNR. A further three non-designated sites were designated for reptiles north of the River Thames within the study area: Lytag Brownfield LWS, Mardyke LWS and Cranham Marsh SINC (refer to Table 8.20).

8.4.128 Low to good populations of all four common reptile species (adder *Vipera berus*, grass snake, slow-worm and common lizard) were recorded to the north of the River Thames. These reptiles were identified in 23 different sites, with 14 of these sites identified as 'key reptile areas'.

8.4.129 The habitats within the study area to the north of the River Thames support areas of ancient semi-natural broadleaved woodland, neutral grassland, species-poor semi-improved grassland and hedgerows. These provide potentially suitable habitat for reptiles.

8.4.130 The reptile assemblage is considered to be of county level importance due to the number of key reptile sites and the presence of all four common reptile species. The reptile population within the study area is likely to form a critical part of the wider Essex population, being important for genetic exchange at this scale. The loss of the reptile population within the study area would therefore be likely to adversely affect the conservation status and distribution of reptiles at a county scale. Further details regarding the baseline conditions are provided in Appendix 8.6: Reptiles (Application Document 6.3).

Ornithology

8.4.131 There are 11 non-designated sites designated for birds north of the River Thames within the study area: Clay Tye Wood ASNW, Blackshots Nature Area LWS, Cranham Hall Shaws and Pasture SINC, Puddle Dock Angling Centre SINC, Jermains Wood SINC, Stubber's Outdoor Pursuit Centre SINC, North Ockendon Pit SINC and Pot Kiln Wood and Sickle Wood SINC, Tylers Common SINC, Fairplay Farm SINC and Ingrebourne Valley SINC.

8.4.132 Although the Thames Estuary and Marshes SPA and Ramsar site are mostly relevant to the River Thames section of this chapter, the functionally linked land associated with these sites is within this geographical section and their habitats are also relevant to the ornithology baseline conditions here. Within the study area to the north of the River Thames, this functionally linked land primarily comprises arable farmland, marshes and coastal grazing marsh, as well as areas of reedbed. See Table 8.17 for a summary of these designated sites and their associated ornithological features.

8.4.133 In addition to the wider area of functionally linked land associated with the Thames Estuary and Marshes SPA and Ramsar site, the habitats that are most suitable for birds north of the River Thames can largely be grouped into two key areas:

a. The marshes surrounding Tilbury Fort

b. The scrub and grassland areas of East Tilbury landfill, extending to the south of Goshems Farm across to the site of the former Tilbury Power Station

8.4.134 The marshes around Tilbury Fort were found to support a significant nocturnal roost for dunlin and other wading birds, including five qualifying species of the Thames Estuary and Marshes SPA and Ramsar site: avocet, black-tailed godwit, dunlin, redshank and ringed plover. They also supported 11 species that are either non-qualifying species of interest or otherwise noteworthy in relation to these designated sites, being either specifically listed as forming part of the assemblage qualification, species of conservation concern (Eaton *et al.,* 2015) and/or included on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). Further details regarding those species are included within Appendix 8.7: Ornithology (Application Document 6.3). The other areas classified as functionally linked land (see Figure 8.10 (Application Document 6.2)) north of the River Thames were found to support four qualifying species of the Thames Estuary and Marshes SPA and Ramsar site: black-tailed godwit, dunlin, redshank and ringed plover at lower densities and frequencies. They also supported eight species which are either non-qualifying species of interest or otherwise noteworthy in relation to these designated sites, also at lower densities and frequencies than in the marshes around Tilbury Fort.

8.4.135 The scrub and grassland areas of East Tilbury landfill, extending to the south of Goshems Farm across to Tilbury Power Station were found to have a significant assemblage of red and amber listed (Eaton *et al*., 2015) breeding birds (notable species including nightingale, cuckoo, corn bunting *Emberiza calandra* and grasshopper warbler.

8.4.136 The remaining areas primarily comprised arable farmland with hedgerows, as well as some areas of woodland, scrub, grassland and open water. These were found to have a typical assemblage for the habitats present (notable recorded species including yellow wagtail *Motacilla flava*, lapwing, skylark and linnet *Linaria cannabina*).

8.4.137 Species listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) that were recorded breeding included peregrine, hobby *Falco subbuteo* and Cetti's warbler. Two confirmed peregrine breeding sites were recorded, one of which was on Tilbury Power Station, which has since been demolished. Two confirmed and two probable hobby breeding sites were recorded. Cetti's warbler were mainly associated with the ditch features across the functionally linked land area and the Mardyke, as well as three other water bodies north of the River Thames (see Figure 8.22 (Application Document 6.2) for full locations).

8.4.138 Short-eared owl were recorded north of the River Thames on five separate occasions foraging in the functionally linked land habitats between Tilbury Power Station and Coalhouse Fort. Short-eared owl is included in the citation for the South Thames Estuary and Marshes SSSI (see Table 8.8) as being a specially protected species that is found within the site, although it is not a notifiable feature that is included as part of the SSSI designation. The observations of short-eared owl to the north of the study area were of non-breeding birds and it is not considered likely that this species was breeding in the area.

8.4.139 Barn owl surveys and a desk-study search recorded 10 structures as breeding sites for barn owl north of the River Thames (the locations have been made confidential due to this species' sensitivity; details are included in Appendix 8.7 (Application Document 6.3)). In addition to the results of targeted breeding surveys, barn owls were observed on 29 separate occasions, primarily foraging across the area between Tilbury Power Station and Coalhouse Fort. The population of barn owls within the study area north of the River Thames is considered to represent a critical part of the wider Essex population and is therefore of county importance. It is also a declining species of conservation concern and is specially protected whilst breeding.

8.4.140 Marsh harrier were recorded north of the River Thames, although no evidence was found to suggest the presence of breeding or roosting sites here. Individuals were recorded foraging, commuting and in one case attempted displaying across the functionally linked land areas on 19 separate occasions and over Ockendon Landfill on one occasion. It is likely that the birds observed form part of the same population recorded to the south of the River Thames, since six of the records included birds crossing the Thames. Given the birds observed to the north of the Thames are likely to be part of the same population as recorded to the south, the marsh harrier population is considered to be of county importance.

8.4.141 The general assemblage of breeding and non-breeding birds within the study area to the north of the River Thames is considered to be of regional importance. This is because it supported species that are likely to form a critical part of the regional assemblage of birds and the loss of these populations would be likely to adversely affect the conservation status and distribution of birds at a regional scale. Furthermore, the assemblage supports species that are qualifying features of the Thames Estuary and Marshes SPA and Ramsar site or which are included as part of the qualifying bird assemblage of the designated sites, as well as other species of conservation concern that are either uncommon and/or specially protected under Schedule 1 of the Wildlife and Countryside Act 1981 (as amended).

Bats

8.4.142 There is one site of national importance that is designated for its bat interests within the study area to the north of the River Thames: Hangman's Wood and Deneholes SSSI which is 307m west of the Order Limits. There are five non-designated sites designated for bats within the study area to the north of the river: Puddle Dock Angling Centre SINC, Hall Farm Moat, paddock and St Mary Magdalene Churchyard, North Ockendon SINC, Stubber's Outdoor Pursuits Centre SINC, Fairplay Farm SINC and Ingrebourne Valley SINC.

8.4.143 Desk study records identified nine species. Hibernation roosts were identified for four species and two species groups (*Myotis* sp. and *Pipistrellus* sp.). No maternity roosts were found within the desk study survey area.

8.4.144 Woodland assessments for roosting bats were carried out in three woodlands north of the River Thames. Of the three woodlands, two were identified as having a high value to roosting bats (East Tilbury Battery and Rainbow Shaw Woodland). The remaining woodland, The Wilderness, was assessed as having a moderate value to roosting bats. The criteria for determining the value of woodland for bats is given within Appendix 8.8: Bats (Application Document 6.3).

8.4.145 Bat surveys recorded a minimum of seven species within the ZoI as well as *Myotis* species and big bat species groups. One confirmed record of barbastelle onsite was from a transect survey immediately north of the River Thames near Coalhouse Fort and is considered to be a single individual foraging or commuting and is expected not to regularly reside within the study area. This is the only Annex II species recorded onsite.

8.4.146 Of the 221 structures assessed north of the River Thames, 10 were found to contain roosts. DNA analysis confirmed four of the structures as brown long-eared roosts (Benton Farmyard (Building 12, a hayloft), Benton Farmyard (Building 15b, a workshop), Manor Farmhouse, Manor Farm Barn). Four structures contained single common pipistrelle day roosts (2 Grays Corner Cottage, 1 Bridge Cottage, Yellowstock Mews and Estate House). One structure (The Rosary main house) was identified as a common pipistrelle and soprano pipistrelle day roost. The remaining confirmed roost was found within St Mary Magdalene Church North Ockendon, which is part of a SINC site designated in part for its bat roost. Alde Cottage was classified as a likely roost due to two common pipistrelle potentially emerging from the garage. Additionally, at Yellowstock Mews two common pipistrelle were seen potentially

emerging from the building or a tree directly behind the building (full details provided within Appendix 8.8: Bats (Application Document 6.3)).

8.4.147 Two noctule roosts were identified in two trees. Tree 1003 was a confirmed noctule maternity roost. Tree 1036 was a suspected noctule day roost. There were three likely roosts identified in trees within the Order Limits (Tree 183, Tree 116 and Tree 185). Tree 116 had a possible single noctule emergence. Tree 183 had a likely noctule and *Myotis* species emergence and two likely common pipistrelle emergences. Tree 185 had one likely soprano pipistrelle emergence from the tree or one in the area. Tree 1015 had a polished opening indicating it is in use by bats, and this is considered a probable bat roost. Additionally, there were a further 130 high and 266 moderate suitability trees for roosting bats identified within the Order Limits and 50m buffer.

8.4.148 There were four key commuting routes identified within the study area to the north of the River Thames: Hoford Road (Crossing Point 6, and Transect 14), an unnamed hedgerow between the Mardyke and a reservoir in the vicinity of Fen Lane (Crossing Point 9, Transect 19), north of Green Lane (Crossing Point 8, Locations 1 and 2) and along the Tilbury Loop railway line (Transect 13, Position 2 and 3). However, bats were likely using the majority of unlit linear features.

8.4.149 The bat population to the north of the River Thames is considered to be of county importance. This is because there were relatively moderate levels of overall bat activity throughout the site with peaks in certain locations of relatively high bat activity, particularly near waterbodies, thus the population is likely to form a critical part of the Essex population.

8.4.150 Further details regarding the bat baseline conditions are presented in Appendix 8.8: Bats (Application Document 6.3).

Dormice

8.4.151 The dormouse surveys of the study area to the north of the River Thames returned a single ‘inconclusive’ nest. Due to the lack of any desk-study records or any other signs of dormouse, it is considered unlikely that dormouse are present within this study area. Dormouse are therefore not considered further, north of the River Thames.

8.4.152 Further details regarding the dormouse baseline conditions are presented in Appendix 8.9: Dormouse (Application Document 6.3).

Water voles

8.4.153 No designated sites were found for water voles within the study area north of the river. Three non-designated sites north of the river had water vole on the designation: Fields South of Cranham Marsh SINC, Puddle Dock Angling Centre SINC and Ingrebourne Valley SINC.

8.4.154 The water vole survey of the study area to the north of the River Thames found three separate populations. The largest number of water vole were found within the ditches immediately adjacent to the River Thames, south of the Tilbury Loop railway line. In addition, there were two smaller, more isolated populations across the study area, one found in a lake close to Linford, and one in the watercourses associated with the Mardyke.

8.4.155 North of the River Thames the water vole population is likely to form a critical part of a wider regional population and is therefore considered to be of regional importance. Furthermore, water voles:

a. are legally protected under Schedule 5 of the Wildlife and Countryside Act 1981

b. are listed as Endangered in England under the IUCN Red List

c. are an Essex priority species and is listed as a Species of Principal Importance under section 41 of the NERC Act 2006

d. are under threat in the UK

8.4.156 Further details regarding the water vole baseline conditions are presented in Appendix 8.10: Water Vole (Application Document 6.3).

Otters

8.4.157 Otter were located across the study area to the north of the River Thames, with confirmed populations in the vicinity of the M25 and the Mardyke, and a probable record located in the ditches immediately to the north of the River Thames. No confirmed otter holts or resting sites were identified within the study area, although an absence of resting sites could not be concluded, given the difficulties in locating, and assessing any use of, such sites.

8.4.158 To the north of the River Thames, the presence of otters on two separate watercourses within the study area would represent a critical part of the Essex population and, therefore, otters are considered to be of county level importance. Furthermore, otters:

a. are legally protected under Schedule 5 of the Wildlife and Countryside Act 1981 and are a European Protected Species

b. are an Essex priority species and is listed as a species of Principal Importance under section 41 of the NERC Act 2006

c. are recovering in the south-east but are not known to be widely distributed or abundant within the region

8.4.159 Further details regarding the otter baseline conditions are presented in Appendix 8.11: Otter (Application Document 6.3).

Badgers

8.4.160 Badger were located across the study area to the north of the River Thames. There were a total of 20 main setts identified, spread throughout the study area. Main setts were distributed across the Project, with a concentration of nine main setts located immediately north of the River Thames. In addition, there were a total of 224 other setts (annex, subsidiary and outlier setts) within 500m of the Order Limits north of the River Thames.

8.4.161 Although not considered to be a species of conservation concern, badger and their setts are nonetheless afforded legal protection under the Protection of Badgers Act 1992. Badger are therefore regarded as an ecological feature of local importance.

8.4.162 Due to the sensitivities of badger records, further details regarding the badger baseline conditions are presented in the confidential badger appendix of Appendix 8.12: Badger (Confidential) (Application Document 6.3).

Other notable mammals

8.4.163 Of the three other mammals considered as part of this assessment (brown hare, harvest mouse and hedgehog), one non-designated site was designated for harvest mouse and brown hare within the study area north of the river: Fairplay Farm SINC. Of these three species, both brown hare and harvest mouse were recorded in small numbers within the study area to the north of the River Thames. Brown hare were recorded on two occasions within the Order Limits north of the River Thames, always as single individuals.

8.4.164 A total of 17 harvest mouse nests were recorded within the study area to the north of the River Thames, with nine of these records within the Order Limits.

8.4.165 Hedgehog are likely to be found in small numbers within suitable habitat within the study area. However, no incidental observations of hedgehog were made during any of the nocturnal ecology surveys, such as those for bats, GCN or birds.

8.4.166 Given the populations of other mammals within the ZoI to the north of the River Thames are likely to be small, none are considered to be of appreciable importance and likely significant effects on these receptors would not occur as a result of the Project. They are, as such, not considered further in this assessment.

8.4.167 Further details regarding baseline conditions of other mammals are presented in Appendix 8.13: Other Mammals (Application Document 6.3). A summary of the baseline ecological conditions and importance for ecological features present to the north of the River Thames is provided in Table 8.26.

Table 8.26 Summary of baseline ecological conditions and importance for ecological features north of the River Thames

Biodiversity feature	Summary description and rationale	Importance	Appendix	Tables/ figures
Lower plants	Lichen assemblage at Low Street Pit LWS, Mucking Heath LWS, the Wilderness Woodland and the woodland around junction 29 of the M25 found terricolous and uncommon lichens including the species *Cladonia ubbute, C. chlorphaea, Physconia distorta* and *Fellhaneropsis vezdae*.	County	8.2	Table 8.21, Figures 8.4 –8.6
Terrestrial invertebrates	Ten areas were identified as being suitable for invertebrates of conservation interest.	National	8.3	Table 8.22,

Biodiversity feature	Summary description and rationale	Importance	Appendix	Tables/ figures
	Invertebrate assemblages associated with open, early successional habitats were well represented in many survey areas. The brownfield sites adjacent to the River Thames hosted a diverse invertebrate assemblage including several brownfield 'flagship' species, which are species of principal importance, along with a cuckoo wasp which was considered extinct in the UK. The invertebrate assemblage associated with a 'rich flower resource' was present in many of the survey areas.			Figure 8.7
Freshwater species – macroinvertebrates	The macro-invertebrate communities within the Mardyke were of a low conservation status, with only one species of note recorded. Ditches surveyed near to the proposed North Portal reported several species of conservation interest. However, many of the species identified across the sites are known to exist elsewhere and were recorded in low abundances.	County	8.4	Table 8.23, Table 8.24
Freshwater species – macrophytes	Very low diversity reported from the twelve surveyed sites.	No appreciable importance	8.4	N/A
Freshwater species – fish	Historical fisheries data for the four Mardyke sites found catches were mainly of coarse fish and minor species in low densities. Three of the four sites surveyed reported European eel, which are listed on the IUCN Red List as Critically Endangered.	Regional	8.4	N/A
Amphibians – GCN	The habitats within the GCN study area to the north of the River Thames provide potentially suitable terrestrial habitats for GCN. 275 ponds within the study area to the north of the River Thames were initially identified through desk study and Phase 1 surveys. GCN presence was confirmed at 41 of them, and the desk-study results indicate an extensive distribution of GCN in the wider landscape.	County	8.5	Table 8.25, Figure 8.8

Biodiversity feature	Summary description and rationale	Importance	Appendix	Tables/ figures
Amphibians – common toad	All standing water is considered potentially suitable breeding habitat for common toad. Some of the terrestrial habitat within the Order Limits is considered potentially suitable for foraging, hibernation and dispersal. There were two incidental sightings of common toad. Common toad was recorded at one pond within the study area during targeted GCN surveys.	County	8.5	N/A
Reptiles	Cranham Brickfields LNR and Lytag Brownfield LWS are within the study area and are designated, in part, for reptiles. All four common reptile species were identified across 23 different sites in low to good populations. Of these sites, 14 were identified as 'key reptile areas'. Habitats within the study area provide potentially suitable habitat for reptiles.	County	8.6	Figure 8.9
Ornithology – general assemblage	Three areas were identified as having the most suitable habitat for birds. These areas supported species that are either qualifying features of the Thames Estuary and Marshes SPA and Ramsar site or which are included as part of the qualifying bird assemblage of Clay Tye Wood and Blackshots Nature Area LWS. Other species of conservation concern that are either uncommon and/or specially protected under Schedule 1 of the Wildlife and Countryside Act 1981 were also present in these areas.	Regional	8.7	Figures 8.10 – 8.17; 8.21 – 8.22
Ornithology – Short-eared owl	Short-eared owl recorded on five occasions. The observations were of non-breeding birds and not considered likely breeding in the area.	No appreciable importance	8.7	Figure 8.22
Ornithology – barn owl	Barn owls were observed on 29 separate occasions. The study area is likely to support a significant proportion of the county population.	County	8.7	Figure 8.20
Ornithology – marsh harrier	Marsh harrier was recorded on 19 separate occasions. The birds observed are likely to be part of the same population as south of the River Thames.	County	8.7	Figure 8.21

Biodiversity feature	Summary description and rationale	Importance	Appendix	Tables/ figures
Bats	The bat assemblage within the study area north of the River Thames was found to be typical of the habitats present. Ten buildings were identified as confirmed bat roosts and three likely roosts identified in trees. There were four key commuting routes identified within the study area to the north of the River Thames with high average nightly passes.	County	8.8	Figures 8.23 – 8.25
Dormice	It is considered unlikely that dormouse are present in the study area.	No appreciable importance	8.9	Figure 8.26
Water voles	Three separate populations were found in the study area, in particular within the ditches immediately adjacent to the River Thames, south of the Tilbury Loop railway line. The populations north of the River Thames are likely to represent a significant proportion of the regional population.	Regional	8.10	Figures 8.27 & 8.28
Otters	Otter were located across the study area to the north of the River Thames, with confirmed populations in the vicinity of the M25 and the Mardyke. No confirmed otter holts or resting sites were identified within the study area. Otter are recovering in the south-east but not widely distributed or abundant within the region.	County	8.11	Figure 8.27
Badgers	There were a total of 20 main setts with nine main setts immediately north of the River Thames. In addition, 224 other setts were identified across the study area.	Local	8.12	Figures 8.29 & 8.30
Other notable mammals	Brown hare were recorded on two occasions, always as single individuals. A total of 17 harvest mouse nests were recorded within the study area. No incidental observations of hedgehog were made during any of the nocturnal ecology surveys. The populations of other mammals within the study area are likely to be small.	No appreciable importance	8.13	Figure 8.31

Nitrogen Deposition Compensation Sites

Plants and Habitats

8.4.168 A full description of the plants and habitats baseline conditions is presented in Appendix 8.22: Terrestrial Ecology Surveys at Nitrogen Deposition Compensation Sites (Application Document 6.3). A summary of the key plant and habitat features present within the study area of the nitrogen deposition compensation sites is provided in Table 8.27 below.

Table 8.27 Summary evaluation of plants and habitats within the nitrogen deposition compensation sites

Habitat type	Level of importance	North of the River Thames			South of the River Thames				
		Hole Farm East (MAol1_A)	Buckingham Hill (MAol2_A)	Hoford Road (MAol2_B)	Henhurst Hill (MAol3_A)	Fenn Wood (MAol3_D1)	Court Wood (MAol3_D2)	Blue Bell Hill (MAol4_C)	Burham (MAol4_C2)
Area-based habitats (ha)									
Lowland mixed deciduous woodland	County	2.54ha	–	0.04ha	–	0.26ha	1.02ha	0.35ha	0.01ha
Other woodland; broadleaved	County	–	–	0.20ha	–	–	–	–	–
Bramble scrub	Local	0.12ha	0.12ha	0.15ha	–	–	0.33ha	–	–
Mixed scrub	Local	0.28ha	5.13ha	1.31ha	–	–	0.15ha	–	0.01ha
Lowland meadows	County	–	–	1.61ha	–	–	–	–	–
Other neutral grassland	County	–	19.14ha	2.34ha	0.04ha	–	3.14ha	–	–
Modified grassland	No appreciable importance	0.01ha	–	–	0.01ha	5.46ha	0.02ha	0.91ha	–
Ponds	County	0.05ha	–	–	–	–	–	–	–
Actively worked sand pit quarry or open cast mine	No appreciable importance	–	<0.01ha	–	–	–	–	–	–
Cereal crops	Local	64.31ha	<0.01ha	15.14ha	8.30ha	–	23.5ha	69.15ha	9.55ha
Arable field margins cultivated annually	Local	5.55ha	–	–	–	–	–	0.75ha	–
Arable field margins pollen & nectar	Local	1.60ha	–	–	–	–	–	–	–

Habitat type	Level of importance	North of the River Thames			South of the River Thames				
		Hole Farm East (MAol1_A)	Buckingham Hill (MAol2_A)	Hoford Road (MAol2_B)	Henhurst Hill (MAol3_A)	Fenn Wood (MAol3_D1)	Court Wood (MAol3_D2)	Blue Bell Hill (MAol4_C)	Burham (MAol4_C2)
Arable field margins tussocky	Local	–	–	–	0.62ha	–	–	0.21ha	–
Artificial unvegetated, unsealed surface	No appreciable importance	–	–	<0.01ha	–	–	–	–	–
Ruderal/Ephemeral	Local	–	–	–	–	–	–	–	0.01ha
Vacant/derelict land/ bareground	No appreciable importance	–	–	–	–	–	–	–	0.13ha
Developed land; sealed surface	No appreciable importance	0.59ha	–	–	–	–	<0.01ha	1.16ha	–
Vegetated garden	No appreciable importance	0.01ha	–	–	–	0.01ha	0.03ha	–	0.01ha
Linear Habitats (km)									
Line of Trees (Ecologically valuable)	County	1.66km	–	–	0.13km	–	0.16km	–	0.12km
Ditches	Local	0.07km	–	–	–	–	0.03km	–	–
Dry ditch	Local	2.84km	0.83km	–	–	–	–	–	–
Other Rivers and Streams	County	0.45km	–	–	–	–	–	–	–
Native Hedgerow	Local	1.93km	0.12km	–	0.12km	<0.01ha	0.12km	1.50km	0.46km
Native Hedgerow with trees	Local	0.15km	–	–	–	–	–	–	–
Native Species Rich Hedgerow	County	–	–	0.21km	–	–	0.37km	0.19km	0.23km

Great crested newts

8.4.169 Twelve water bodies across the nitrogen deposition compensation sites were subject to habitat suitability index (HSI) and eDNA surveys. HSI suitability ranged from Poor to Excellent, and 11 of the 12 ponds returned a Negative eDNA result. Pond 9 in Court Wood, south of the River Thames, returned a positive eDNA result.

8.4.170 It was not possible to complete additional surveys to provide an estimate of population class size so the valuation for this receptor is precautionary, based on an assumed population class size of medium; this approach was agreed with Natural England during discussions over the draft licensing approach for the Project. The populations of GCN within the nitrogen deposition compensation sites are therefore considered to be of county importance for biodiversity.

8.4.171 A full description of the GCN baseline conditions is presented in Appendix 8.22: Terrestrial Ecology Surveys at Nitrogen Deposition Compensation Sites (Application Document 6.3).

Badgers

8.4.172 Two outlier setts were identified within the nitrogen deposition compensation sites: one of these setts was active, the other was a disused sett.

8.4.173 Although not considered to be a species of conservation concern, badger and their setts are nonetheless afforded legal protection under the Protection of Badgers Act 1992. Badger are therefore regarded as an ecological feature of local importance.

8.4.174 A full description of the badger baseline conditions is presented in Appendix 8.22: Terrestrial Ecology Surveys at Nitrogen Deposition Compensation Sites (Application Document 6.3). A summary of the baseline ecological conditions and importance for the ecological features present within the nitrogen deposition compensation sites is provided below in Table 8.28.

Table 8.28 Summary of baseline ecological conditions and importance for the ecological features within the nitrogen deposition compensation sites

Biodiversity feature	Summary description and rationale	Importance	Appendix	Tables/ Figures
GCN	A single positive eDNA result was returned from a single pond within the nitrogen deposition compensation sites.	County	8.22	Figure 5
Badger	Two outlier setts were recorded within the nitrogen deposition compensation sites.	Local	8.22	Figure 8.34 (Application Document 6.2)

Future baseline ('Without Scheme' scenario)

8.4.175 The future baseline identifies anticipated changes to the existing baseline over time in the absence of the Project and is used as a basis against which to predict the potential impacts of the Project. A description of how the future

baseline has been considered within the assessment is provided in Chapter 4: EIA methodology.

8.4.176 The future baseline describes the biodiversity features as they would be at the time of the commencement of construction of the Project (2024). They are influenced by future developments and factors that have a high degree of uncertainty such as future land management and climate change. Where information exists on planned future developments, this has been taken into consideration during the assessment. This includes, for example, forecast changes in traffic that would affect air quality and may then have implications for habitat structure and diversity.

8.4.177 Natural and semi-natural habitats have declined significantly in extent and quality throughout the 20th century, largely due to changes to agriculture and land management. This decline has slowed substantially, though these pressures and others such as development, climate change and biotic influences, such as INNS and pathogens, continue.

8.4.178 Data from the Biodiversity Indicator Assessment (Department for Environment, Food and Rural Affairs, 2016) does not detail long-term trends for habitats, making it difficult to predict their future status in the absence of a proposed development. However, a general increase in favourable condition of priority habitats has been identified through Higher Level Stewardship reporting, which is consistent with the Government's target to have '90% of priority habitats in favourable or recovering condition' (Department for Environment, Food and Rural Affairs, 2011).

8.4.179 Intensive farmland, comprising improved or species-poor semi-improved grassland and arable land, accounts for approximately 59% of the land within the study area for the Project. Analysis of trends in used agricultural areas in England shows a slight decline in its total extent over the last decade, with urban pressures associated with an increased population resulting in the expansion of the built environment. However, overall, the amount of land under agricultural production within the study area is likely to remain relatively constant during the life-span of the Project, despite some small-scale changes being likely, particularly as Thurrock's Local Plan is developed.

8.4.180 There is still much uncertainty surrounding the effect that climate change will have on biodiversity, particularly where there is interaction with other pressures. UK Climate Projections (UKP09) predict a 3˚C temperature rise by 2100. Broad habitats are unlikely to be significantly affected by a temperature increase by the opening year/year of operation of the Project. Relative abundance of individual plant species may change, though the composition of the plant communities is likely to remain relatively stable. However, sea level rise associated with climate change could result in land adjacent to the River Thames, notably habitats such as coastal and grazing marsh, being inundated more frequently, leading to a change in species composition towards more salt-tolerant species.

8.4.181 Plant pathogens pose a risk to both plants and habitats. For instance, increased incidence of tree pathogens such as ash dieback *Chalara fraxinea* and sudden oak death *Phytophthora ramorum* could drastically alter the canopy composition of broadleaved woodland, although it is not currently clear how virulent such

diseases will be in the UK. In this instance, changes to canopy composition are most likely to result in a decline in condition and quality of the habitats, though the broad habitat types are likely to remain constant.

8.4.182 The impacts that climate change may have on terrestrial invertebrates have been summarised in Report Cards published by the Living With Environmental Change Network (Morecroft and Speakman, 2015). Climate warming has resulted in northward range shifts of many southern and common British invertebrates and changes in butterfly communities. A number of invertebrates have colonised the southern UK from Europe in recent years and are expanding their range northwards. Although areas of climate suitability might increase for some species, not all species will be able to change distribution with changing climate, particularly in fragmented landscapes. Some invertebrate species may change their habitat use through behavioural or evolutionary processes.

8.4.183 Long-term climatic predictions suggest that warmer, wetter winters and drier summers will become more frequent in England, with more extreme weather events likely (Department for Environment, Food and Rural Affairs, 2011). Combined with changes in land management, increased urbanisation and increased biotic pressures, climate change may lead to an increase in the population and distribution of some species in the UK, such as certain species of migratory birds, for example, but a decrease in other species, such as water vole. In the absence of robust datasets to predict the future status of the condition and extent of habitats and species populations, it is assumed that the future baseline will, in general, be relatively similar to its current state, and the value of the ecological features that are relevant to the Project would be consistent with that of the existing baseline conditions described above. As such, the importance established for ecological features described within the existing baseline are considered to be appropriate for the future baseline with a 'Without Scheme' scenario.

8.4.184 As part of a planning permission granted in relation to the IVL scheme to the east of Tilbury, an area encompassing approximately 290ha of land is to be subject to phased habitat restoration by 2032, following the completion of the ongoing removal of PFA deposits from within this area (D.K. Symes Associates, 2017 and 2019). This includes the entirety of the area that falls within terrestrial invertebrate Survey Area 3 (refer to Figure 8.7 (Application Document 6.2)), Goshems Farm LWS, and other areas of agricultural land that fall within the Order Limits for the Project. To inform this assessment, the future baseline conditions for the Project have been established from the aspirational masterplan for the IVL scheme (D.K. Symes Associates, 2019), rather than the consented masterplan, as this is considered suitably precautionary. This includes the retention of approximately 12ha of land that falls within Goshems Farm LWS. Under IVL's aspirational masterplan, the remaining area of the LWS is to be restored as arable farmland, which is of lower value to biodiversity, as would the majority of the area that falls within terrestrial invertebrate Survey Area 3. Within terrestrial invertebrate Survey Area 3, only the riparian margins either side of existing retained watercourses, the retained 12ha of scrub, tall ruderal habitat and grassland that falls within Goshems Farm LWS, and an area of open mosaic habitat to the west of the Order Limits, would be managed under the aspirational masterplan to promote biodiversity (D.K. Symes Associates, 2019). It is therefore likely that the future baseline conditions in this

area would continue to represent an overall deterioration in biodiversity value from those conditions that were observed during the baseline surveys for the Project. Nevertheless, the valuation of this area that was presented above for the existing baseline conditions has been considered, on a precautionary basis, to be representative of the future baseline conditions for the purpose of this assessment.

8.4.185 Natural England are currently considering notification of a new SSSI in an area around the North Thames estuary and marshes, the focus of special scientific interest being the assemblages of terrestrial invertebrate, plant and bird species the area supports. Natural England has shared with the Project its high-level considerations around which areas may warrant SSSI notification, and the Project has supported Natural England's study through the provision of baseline survey data to inform this work. Although Natural England's timescale for notification are likely to be after the Project's application submission, the Project has taken this likely notification into account when designing its landscape and mitigation strategy, and has done so in consultation with Natural England (see Statements of Common Ground (Application Document 5.4)).

8.5 Project design and mitigation

8.5.1 Environmental considerations have influenced the Project throughout the design development process, from early route options assessment through to refinement of the Project design (see Chapter 2: Project Description). An iterative process has facilitated design updates and improvements, informed by environmental assessment and input from the Project engineering teams, stakeholders and public consultation.

8.5.2 The Project includes a range of environmental commitments. Commitments of relevance to terrestrial biodiversity are set out in this section under the following categories:

a. Embedded mitigation: measures that form part of the engineering design, developed through the iterative design process summarised above.

b. Good practice: standard approaches and actions commonly used on infrastructure development projects to avoid or reduce environmental impacts, typically applicable across the whole Project.

c. Essential mitigation: any additional Project-specific measures needed to avoid, reduce or compensate potential impacts that could otherwise result in effects considered significant in the context of the EIA Regulations. Essential mitigation has been identified by environmental topic specialists, taking into account the embedded and good practice mitigation.

8.5.3 Embedded mitigation is included within the Design Principles (Application Document 7.5) or as features presented on Figure 2.4: Environmental Masterplan (Application Document 6.2). Design Principles relevant to mitigation of effects on terrestrial biodiversity are described below, each with an alpha-numerical reference code (LSP. XX). Good practice and essential mitigation are included in the Register of Environmental Actions and Commitments (REAC). The REAC forms part of Appendix 2.2, the Code of

Construction Practice (CoCP) (Application Document 6.3). Each entry in the REAC has an alpha-numerical reference code (REAC Ref. TB0XX) to provide cross reference to the secured commitment. Relevant good practice and essential mitigation to reduce terrestrial biodiversity effects are identified below.

8.5.4 The Design Principles (Application Document 7.5), Environmental Masterplan (Application Document 6.2), CoCP and REAC (Application Document 6.3, Appendix 2.2), all form part of the Project control plan. The control plan is the framework for mitigating, monitoring and controlling the effects of the Project. It is made up of a series of 'control documents' which present the mitigation measures identified in the application that must be implemented during design, construction and operation to reduce the adverse effects of the Project. Further explanation of the control plan and the documents which it comprises is provided in the Introduction to the Application (Application Document 1.3).

8.5.5 Enhancement measures have been directly incorporated into the Project as part of the application of 'good design' principles. Enhancements are measures that are considered to be over and above any measures to avoid, reduce or remediate adverse impacts of the Project. Relevant beneficial effects arising as a consequence of this good design process are provided below.

Embedded mitigation

Construction phase

8.5.6 The route corridor has been designed to be a biodiverse wildlife corridor connecting suitable habitats throughout the wider landscape (see the Design Principles (Application Document 7.5) Clause no. PLA.05). South of the River Thames the landscape design provides a north-south link between the River Thames, the marshes south of the River Thames, and the areas of ancient woodland around the A2/M2 (see Figure 2.4: Environmental Masterplan (Application Document 6.2)). North of the River Thames the landscape planting has been designed to provide a corridor between the M25 in the north-west, the Mardyke, the A13 and connecting to the River Thames in the south-east.

8.5.7 Close to the Mardyke, the Project would include a viaduct with sufficient clearance height (4–5m headroom) to allow animals, (including bats and low-flying bird species such as barn owls) to commute below it, mitigating potential fragmentation effects. There would be a river bridge over the Orsett Fen Sewer, with the same clearance as the Mardyke Viaduct. This river bridge is designed to accommodate farm vehicles as well as allowing for free passage of the Orsett Fen Sewer. It would therefore allow free movement of species beneath the bridge (see the Design Principles (Application Document 7.5) Clause no. PLA.05, STR.08, STR.01, STR.04, STR.06, S12.03, S12.04, S12.05).

8.5.8 Biodiversity connectivity would be maintained by crossings of the Project by seven mixed-use green bridges. Green bridges have been individually designed to provide the greatest benefit at each particular crossing location, with reference given to the Landscape Institute Technical Note for Green Bridges (Landscape Institute, 2015). A summary of the specifications of each green bridge is provided below.

a. Brewers Road green bridge has been designed with a green verge to the east and west of a two-lane road (see Figure 2.4: Environmental Masterplan

(Application Document 6.2)). The western green verge has been designed to have a double hedgerow character with grassland planting in between the hedgerows. The eastern verge would consist of a WCH route and an area of grassland planting with a single hedge line. This green bridge would allow species to cross from the woodland to the north of the A2/M2 to the parkland to the south of the A2/M2, particularly dormouse, which are known to be present in the habitats on either side of the A2/M2. To further increase the connectivity, a mammal culvert will be provided at the north end of the bridge between the existing and new bridge abutments. The culvert will be designed to allow mammal passage and will be designed to integrate into the surrounding environment (see the Design Principles (Application Document 7.5) Clause no. PLA.05, STR.01, STR.06, STR.08, S1.04, S1.23).

b. Thong Lane green bridge south has been designed with a green verge to the west, and a smaller green verge to the east of a two-lane road (see Figure 2.4: Environmental Masterplan (Application Document 6.2)). This western green verge would be planted with a double hedgerow character with grassland planting in between the hedgerows. The eastern green verge would be a single hedge line. This green bridge would allow species to cross over the A2/M2 and link the north and south sides of Shorne and Ashenbank Woods SSSI. Although this green bridge is designed for multiple species, the hedgerows will be designed to connect the dormouse populations present either side of the A2/M2. To further increase the connectivity, a mammal culvert will be provided to the south-west of the bridge under the southern connector road. The culvert will be designed to allow mammal passage and will be designed to integrate into the surrounding environment (see the Design Principles (Application Document 7.5) Clause no. PLA.05, STR.01, STR.06, STR.08, S1.04, S1.14, S2.15).

c. Thong Lane green bridge north is a mixed-use green bridge, consisting of a two-lane road with large southern and northern green verges (in excess of 30m wide) (see Figure 2.4: Environmental Masterplan (Application Document 6.2)). Both these green verges would include a WCH route, grassland areas and hedgerow planting. The hedgerow planting would connect to woodland planting located either side of the route alignment to enhance the landscape for nature, particularly for connecting up the fragmented pocket of ancient woodland at Claylane Wood with the woodland within Shorne Woods Country Park. This will have a benefit for a number of species, but particularly for bats and dormouse commuting across the Project at this location (see the Design Principles (Application Document 7.5) Clause no. PLA.05, STR.01, STR.06, STR.08, S2.04).

d. Green Lane and Hoford Road green bridges have been designed to accommodate terrestrial mammals and bats. These green bridges consist

of a single farm track with a hedgerow on either side. They have been designed along existing key bat commuting routes and would be suitable crossing locations for other species, such as badgers (see the Design Principles (Application Document 7.5) Clause no. PLA.05, STR.01, STR. 06, STR.08, S10.03, S11.11).

e. North Road and Muckingford Road green bridges have been designed to accommodate terrestrial mammals and bats. North Road green bridge has been designed with 7m green verges to the east and west of a two-lane road and WCH route. Muckingford Road green bridge has been designed with 7m wide green verges to the north and south of a two-lane road and WCH route (see Figure 2.4: Environmental Masterplan (Application Document 6.2)). These green verges have been designed to have a strong hedgerow character with open grassland planting, allowing a sheltered corridor across the Project. These sheltered crossings would allow mammals and bats to commute across the bridges, with bats in particular encouraged to use these features by improving the existing hedgerows within the Order Limits leading to the green bridges (see the Design Principles (Application Document 7.5) Clause no. PLA.05, STR.01, STR. 06, STR.08, S10.01, S12.13).

8.5.9 The Mardyke and Orsett Fen Viaducts and the Golden Bridge Sewer Viaduct have been designed to reduce shading and cause the least amount of long-term habitat degradation (see the Design Principles (Application Document 7.5) Clause no. PRO.04, PLA.05, STR.01, STR.04, STR.06, S12.03, S12.04, S12.05, LSP.05). The piers and foundations have been sited so that they would not be located within the watercourses. Where the vegetated banks would be affected, these areas would be restored following construction (see the Design Principles (Application Document 7.5) Clause no. PRO.04, PLA.05, STR.01, STR.04, STR.06, S12.03, S12.04, S12.06, S12.05, LSP.05).

8.5.10 The Project would require culverting at 12 separate locations on eight watercourses. Full details are provided in Section 2.4 of Chapter 2: Project Description and the Design Principles (Application Document 7.5) Clause no. PRO.04, STR.01, S9.10. Where baseline or future baseline conditions suggest that watercourses may be used by commuting or foraging mammals, culverts have been designed to allow mammal passage (see Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. PRO.04, PLA.05, STR.01, S9.10). Mammal ledges would be provided on box culverts, and for pipe culverts a separate dedicated pipe would be installed above flood levels (1% probability flood level, inclusive of climate change). Where culverting would result in the loss of habitat, this would be compensated by improving habitats either side of the culvert location (see the Design Principles (Application Document 7.5) Clause no. PRO.04, PLA.05, STR.01, LSP.01, LSP.02, LSP.05, S9.10).

8.5.11 The provision for mammal passage would be included within the following culverts that would be placed on watercourses that are likely to be used by foraging or commuting mammals:

a. The replacement of an existing culvert under the M25

b. Two box culverts installed immediately to the west of the Mardyke

c. One culvert located to the south of Linford Pond

d. Two culverts on the Tilbury Main river

Operational phase

8.5.12 To mitigate mortality for animals trying to cross the Project, permanent fencing would be erected and vegetation planted in appropriate areas to direct animals to specific crossing locations (see the Design Principles (Application Document 7.5) Clause no. STR.01, STR.09, PRO.04).

8.5.13 To reduce the risk of any GCN fatalities, gully pots would only be included in the drainage design of the Project where no suitable alternative existed to achieve the relevant drainage objective (see the Design Principles (Application Document 7.5) LSP.28).

8.5.14 Mitigation to reduce the risk of mortality of low-flying species (particularly bats) has been included within the Project by the creation of cuttings or false cuttings for large sections of the route (see the Design Principles (Application Document 7.5) Clause no. PRO.04, PLA.05, LSP.09, LSP.20, LSP.21). These features are typically of 2m or more in height and would encourage bats into higher-flying patterns over the Project at a height to reduce the risk of collision (see Christensen *et al.*, 2016). To the south of the River Thames, the Project is in cutting from the South Portal to the M2/A2/A122 Lower Thames Crossing junction. Around the junction the Project would primarily be in false cutting (see Figure 2.4: Environmental Masterplan (Application Document 6.2)). To the north of the River Thames, the Project is in cutting from the M25 south to the Mardyke, where the Project would rise from the cutting to travel over the Mardyke via two viaducts and embankments (see the Design Principles (Application Document 7.5) Clause no. PRO.04, LSP.09, LSP.20, LSP.21). The Project is then in false cutting from 500m north of Green Lane green bridge to the A13 junction. From the A13 junction the Project is in cutting/false cutting south to the Tilbury Loop viaduct, which carries the Project over the Tilbury Loop railway line. It would then be in false cutting to the North Portal.

8.5.15 Lighting has been designed to avoid and reduce impacts on important biodiversity features such as retained areas of ancient woodland and bat roosts. This includes low column heights to reduce light spill, with lighting columns being placed in verges projecting towards the central reserve wherever practicable to reduce light spill into adjacent areas, unlit sections of road to provide dark corridors for photosensitive species and warm white luminaires to reduce the impacts on insects and bats. For full details see Section 2.4 of Chapter 2: Project Description and the Design Principles (Application Document 7.5) Clause no. LST.02, LST.03.

8.5.16 Where significant effects are predicted to occur on designated sites within 200m of the ARN as a result of increased nitrogen deposition on those sites, measures to address the adverse effects would be implemented. Avoidance was achieved as far as possible within the Project's objectives through design. A number of potential mitigation options were considered and feasible mitigation

measures (in the form of speed management measures on the M2) have been proposed to minimise the residual significant effects (REAC Ref. TB025). A number of potential compensation measures were considered, and feasible measures have been proposed to fully compensate for residual significant effects. The compensation strategy proposed consists of landscape scale habitat creation across eight nitrogen deposition compensation sites, located both north and south of the river, and covering an area of 247.7ha. The objectives of the compensation sites is to both increase the amount of high quality wildlife-rich habitat, and position this new habitat to forge strong links between areas of retained semi-natural habitat within the network of designated sites across the wider landscape (see Figure 2.4: Environmental Masterplan (Application Document 6.2), the Design Principles (Application Document 7.5) Clause no. LSP.27, and the oLEMP (Application Document 6.7). This would build resilience of the ecological networks that support the nitrogen deposition affected sites and therefore build the resilience of the affected sites themselves. Details of the strategy and the consideration of the mitigation hierarchy can be seen in the Project Air Quality Action Plan (Application Document 6.3, Appendix 5.6).

Good practice

Construction phase

8.5.17 Pre-construction surveys would be undertaken to ensure robust baselines were available to support detailed design of protected species mitigation strategies, including licensable species, and to avoid the spread of INNS (see Schedule 2 Requirement 7 of the draft DCO (Application Document 3.1) and REAC Ref. TB005 (Application Document 6.3, Appendix 2.2)).

8.5.18 In line with the obligations within the CoCP regarding lighting, construction site lighting will comply with the Institute of Lighting Professionals' Guidance Notes for the Reduction of Obtrusive Light GN01/20 (2020) and the provisions of BS EN 12464-2:2014 Light and lighting – Lighting of workplaces Part 2: Outdoor workplaces (British Standards Institution, 2014), where applicable. The contractor will consult the Environmental Clerk of Works over the application of these guidance and standards to avoid adverse effects on sensitive ecological receptors including retained bat roosts and watercourses. (REAC Ref. TB024).

8.5.19 Surface water runoff would be managed in accordance with DMRB and described in detail in Section 14.5 of Chapter 14: Road Drainage and the Water Environment. This includes appropriate measures to deal with treatment of potential pollutants that could feasibly leak into surface water runoff from haul routes and construction compounds. These mitigation measures would control runoff to surface water and the risk of pollution of local watercourses (see the CoCP (Application Document 6.3, Appendix 2.2)).

8.5.20 Dust suppression measures would be applied to mitigate dust deposition resulting in an adverse effect on the important habitats and designated sites located in the vicinity of the Project. For full details refer to Section 5.5 of Chapter 5: Air Quality.

8.5.21 Temporary fencing would be used to demarcate important and protected habitats, preventing construction access to protect them from accidental damage. Important and protected habitats include ecological translocation sites,

and retained woodland, trees and hedgerows shown on Figure 2.4: Environmental Masterplan (Application Document 6.2). Fencing would be installed under the supervision of the Environmental Clerk of Works (ECoW) and in accordance with good practice guidance. It shall include tree protection measures specified in the Arboricultural Method Statement. (REAC ref. TB002). A suitably qualified and experienced ECoW would be employed throughout the construction phase of the Project to supervise implementation of environmental mitigation and protection commitments (REAC Ref. TB006).

8.5.22 Works compounds, access tracks, haulage routes, material storage areas, generators and other construction activities would not be located within areas of retained vegetation as shown on Figure 2.4: Environmental Masterplan (Application Document 6.2) unless the SoS agrees that any variation does not result in new or materially different significant environmental effects to those reported in the ES. (REAC Ref. TB003).

8.5.23 Any works near watercourses would follow guidance protocols as detailed in Section 14.5 of Chapter 14: Road Drainage and the Water Environment.

8.5.24 Disturbance, and incidental mortality, of breeding birds would be avoided by timing vegetation clearance and structure removal outside of the bird nesting season (March to August inclusive) wherever practicable. Where this is not practicable, appropriate measures would be taken to avoid harming birds or their nests (such as temporary fencing around nesting sites where they are immediately adjacent to construction works), under supervision of a suitably experienced ECoW (see the CoCP (Application Document 6.3, Appendix 2.2) (REAC Ref. TB004)).

8.5.25 Works within the intertidal area to construct or decommission the northern tunnel compound outfall would be undertaken during April, May, June, July and August only, to avoid disturbance to passage and overwintering birds associated with European designated sites unless otherwise agreed with SoS in consultation with Natural England (REAC Ref. HR002).

8.5.26 Invasive species would be identified prior to construction and would be removed or treated to prevent their spread, following the Construction Industry Research and Information Association's (CIRIA) guidance in Wade *et al*. (Invasive Species Management for Infrastructure Managers and the Construction Industry, 2008) (REAC Ref. TB005).

8.5.27 Where habitats that are known or assumed to support protected or notable species, as identified on Figures 8.1 – 8.31 (Application Document 6.2) or referred to in ES Appendix 8.1 – 8.13 (Application Document 6.3), clearance would take place in a phased, directional manner towards areas of contiguous retained habitat. This would encourage mobile species to move from the construction site into the wider landscape. These measures would be implemented under the supervision of the ECoW (REAC Ref. TB013).

Operational phase

8.5.28 Retained and new habitats would be managed having regard for Natural England's The Mosaic Approach: Managing Habitats for Species (2013) to improve both priority habitats and species (REAC Ref. TB007). This means creating and maintaining a variety of habitats including the following:

a. Sheltered areas – for example south-facing banks, scrub/brash piles, log piles.

b. Bare ground – a number of species rely on bare ground as a foraging and breeding resource.

c. Flower-rich habitats – a diverse floral assemblage would help support a wide range of species.

d. Scrub and scattered trees – these provide structural diversity but should not be planted in large blocks.

e. Sward diversity – where feasible, to introduce species that form varying swards (e.g. tussock-forming grass species).

f. Open water – many species rely on ponds and ditches for foraging and drinking resources.

Essential mitigation

Potentially significant effects

8.5.29 An iterative appraisal of the Project design taking into account the design principles and good practice, was undertaken to identify any potentially significant effects that would require essential mitigation. Effects on terrestrial biodiversity that could be significant and therefore required further consideration for essential mitigation were identified as follows:

a. Direct loss of wildlife habitat through land-take

b. Loss of land associated with designated sites, including functionally linked land that falls outside the boundaries of designated sites

c. Severance, by dividing habitats or wildlife corridors

d. Direct mortality of species through construction activities

e. Disruption of local watercourses

f. Indirect effects through construction disturbance, air quality, vibration, noise or hydrological impacts

Construction phase

8.5.30 Hedgerow habitat lost during construction would be compensated by creating new hedgerows at locations shown on the Environmental Masterplan, using native species of local provenance. Planting would be undertaken as early in the construction programme as reasonably practicable, having regard for the completion of potentially damaging construction activities within and adjacent to the planting area, and seasonal requirements for planting (REAC Ref. TB001). This would include a particular focus on maintaining and improving hedgerows in the vicinity of the proposed green bridges, since these features would act as key wildlife corridors across the Project (see the Design Principles (Application Document 7.5) Clause no. PLA.05, LSP.02, LSP.13, STR.08).

8.5.31 The approach to compensatory woodland planting to offset impacts to ancient woodland has been discussed in detail with Natural England, and to a lesser extent with Forestry England. These discussions have led to the focus on this compensatory planting being to create more woodland habitat which forms links between existing woodlands within the wider landscape. This would not only increase the extent of woodland habitat, which would support a range of protected and notably species, but build resilience into the wider habitat network, facilitating the ease of movement for protected species within the landscape.

8.5.32 South of the River Thames, the habitat creation would largely be woodland planting to reduce the impact for the loss of ancient and SSSI woodland during construction of the Project, where approximately 110ha of woodland creation is proposed within the Order Limits. This woodland planting has been designed to link existing areas of woodland including Great Crabbles Wood, Shorne Woods, and Claylane Wood. To ensure the success of the planting, the following objectives/success measures would be adopted:

a. All plant failures to be removed and replanted, with a 90% success rate target of new planting by Year 5.

b. The new woodland areas shall be maintained as agreed in the second iteration of the Environmental Management Plan to achieve the following performance by Year 30:

   i. The vegetation shall form or shall be clearly capable of forming groups of similar species, form and height to those in the vicinity, reflecting local vegetation patterns, structure and nature conservation value (adjacent woodland NVC W10 *Quercus robur – Pteridium aquilinum – Rubus fructicosus* woodland).

   ii. Vegetation within ancient woodland compensation area to comprise at least 50% of indicator species from ancient woodland at Shorne Woods.

   iii. Native ground flora shall have been allowed to develop through provision of a variable light environment including shaded areas beneath a closed canopy, at Year 25.

8.5.33 Areas identified on the Environmental Masterplan for planting to compensate the loss of ancient woodland would be inoculated, where reasonably practicable, with soils salvaged from ancient woodland sites within the Order Limits (as identified on Figure 8.1: Designated Sites (Application Document 6.2)) that would be disturbed by construction activity. All ancient woodland compensation, including soil inoculation, will take place within the Order Limits. The suitability of the soil from the donor sites would be determined by a soil scientist prior to commencement of works in those areas, with consideration for existing ground flora composition and diversity, and potential contamination. The soils would be translocated in advance of construction activities commencing at the donor sites, avoiding weather constraints (e.g. heavy rainfall); timing conflicts with protected species licensing activities (e.g. capture and translocation of dormice); and only after any essential mitigation required for buried archaeology identified within the receptor sites, has been completed.

Soils would typically be stripped to circa 300mm, disturbing the soil structure as little as reasonably practicable and carefully placed within the pre-prepared adjacent receptor sites, following CIRIA Habitat translocation - a best practice guide (C600) (REAC Ref. TB028).

8.5.34 Further details regarding the proposed woodland planting are provided on Figure 2.4: Environmental Masterplan (Application Document 6.2) and in the Design Principles (Application Document 7.5) Clause no. LSP.15, LSP.19, S1.08, S1.14, and S2.01. This connectivity would be further enhanced by the green bridge designs described above.

8.5.35 North of the River Thames the new habitats have been designed to connect existing biodiverse areas, particularly the Thames Estuary and the Mardyke. To achieve this, a number of 'stepping-stone' areas of habitat creation are proposed. Within these areas the habitat would comprise an open mosaic habitat, with a mix of grassland, scrub, bare ground and ponds, with structural diversity and south-facing slopes and banks to create the most diverse habitat suitable for multiple species/groups. These habitats would act as areas from which species can disperse and colonise the Project landscape design and the wider landscape following the completion of construction (Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5), Clause no. LSP.22. To ensure the success of the habitat creation, the following objectives/success measures would be adopted:

a. A dynamic habitat would be created, the value of which is generated through regular disturbance, avoiding habitat succession and retaining structural diversity.

b. Varied microtopography to incorporate south-facing banks which can be created using inert material such as PFA/sands/gravels.

c. Scrub: no greater than 10% coverage.

d. Bare ground: approximately 10% coverage (small patches spread across site rather than single areas).

e. Rough grassland: approximately 30% coverage.

f. Low nutrient, free-draining grassland: 50% coverage (PFA to provide a minimum 20% overall area substrate, left to regenerate naturally).

g. Pond creation required as part of the GCN mitigation strategy (see Appendix 8.17: Draft EPS mitigation licence application – great crested newts (Application Document 6.3)).

h. Establishment of open mosaic habitat in accordance with the structural composition specified within the Design Principles (Application Document 7.5) Clause no. LSP.22.

i. Grassland habitats tending towards MG1 and MG11 NVC communities.

j. Colonisation by diverse invertebrate species assemblage typical of open mosaic habitat along the Greater Thames Estuary National Character Area.

k. Pond creation in line with design approach in GCN mitigation guidelines (English Nature, 2001).

8.5.36 To the north of the River Thames, the Project would primarily be either in cutting or false cutting, with the proposed habitat creation measures comprising a mix of grassland, with areas of scrub/hedgerow and tree planting (see Figure 2.4: Environmental Masterplan (Application Document 6.2)). In areas where grassland would be created, the species mix would be herb-rich and focused on locally prevalent species that would benefit local invertebrate populations (see the Design Principles (Application Document 7.5) Clause no. PRO.04, PLA.05, LSP.02, LSP.04, LSP.09). This would support the Project becoming a wildlife corridor linking the areas around the Thames Estuary to the A13, Mardyke and M25 corridors.

8.5.37 The largest area of habitat creation to the north of the River Thames would be located adjacent to Coalhouse Fort (see Figure 2.4: Environmental Masterplan (Application Document 6.2)). This would comprise approximately 97ha of habitat creation and has been designed to compensate the predicted habitat losses within designated sites to the north of the River Thames, as well as other important semi-natural habitats that fall outside the boundaries of designated sites. It would include a number of different habitats created to enhance the environment adjacent to the River Thames, while also increasing the area's biodiversity value. It would comprise wetland habitat (refer to Design Principles (Application Document 7.5) Clause no. S9.13), together with some areas of ponds, wet grassland and scrapes. The central ditch would also be realigned to increase its length, replicating historic drainage ditches in this area, and would be replanted to increase its biodiversity interest. This ditch would retain its existing salinity gradient, supporting the terrestrial and aquatic invertebrate species present in this area. In addition, areas of open mosaic habitat would be created consisting of wildflower and scrub planting, with numerous south-facing bunds constructed from nutrient poor substrate, bare ground patches and ponds (see the Design Principles (Application Document 7.5) Clause no. LSP.22). This diverse habitat would be suitable for numerous species, with a particular focus on providing features that maximise the suitability of the habitats for terrestrial invertebrates (see Figure 2.4: Environmental Masterplan (Application Document 6.2)).

8.5.38 In addition to the areas around Coalhouse Fort, there will be an area of habitat creation around the North Portal area at Tilbury Fields. This will total approximately 46ha and is designed for terrestrial invertebrates and reptiles, as well as being suitable for a number of species. This habitat creation will consist of open mosaic habitat, with wildflower and scrub planting using species mixes specifically designed to support the range of terrestrial invertebrate species currently recorded here including shrill carder bee, numerous south-facing bunds constructed from nutrient poor substrate and bare ground patches (see the Design Principles (Application Document 7.5) Clause no. LSP.11, LSP.22) (see Figure 2.4: Environmental Masterplan (Application Document 6.2)).

8.5.39 By being similar in composition, the habitats in the vicinity of Coalhouse Fort would complement other habitat creation areas around the Thames Estuary, both in the immediate vicinity of the Project (Mucking Marshes SSSI and Thurrock Thameside Nature Park), and in a wider context (RSPB Cliffe Pools, Wat Tyler Country Park, RSPB Rainham Marshes).

8.5.40 A number of habitat creation areas are proposed within the Order Limits to further improve the Mardyke corridor. These include areas of open mosaic habitat at Linford, adjacent to the Mardyke, south of Thames Chase Community Forest and adjacent to the M25 (see Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.22). In addition, a large area of ditch habitat will be created to the east of the Mardyke which will be suitable for use by water voles and otters.

8.5.41 Where any pond is being removed as part of the construction this will be replaced: by two new ponds for any one pond containing GCN populations, and on a 1:1 ratio for all other ponds. These newly created ponds will be of a similar area, depth and habitat characteristic as the removed ponds (see the Design Principles (Application Document 7.5) Clause no. LSP.31).

8.5.42 During construction works, it would be necessary to permanently divert a number of watercourses, particularly around the Mardyke and the North Portal area (see Figure 2.4: Environmental Masterplan (Application Document 6.2)). Where this occurs, the new watercourses would be planted to ensure they have a greater floral diversity to benefit a wider range of species than the existing watercourses (see Chapter 14: Road Drainage and the Water Environment), and the Design Principles (Application Document 7.5) Clause no. LSP.02, LSP.04, LSP.12, PRO.04, S12.06) (REAC Ref. TB021).

8.5.43 Badger setts identified within the Order Limits for closure would be closed by permanently excluding badgers and then removing the empty setts. The setts would be closed under licence from Natural England outside of the badger breeding season which takes place between 1st December and 30th June. For any main setts that will be closed with no suitable naturally occurring alternative sett, an artificial sett will be constructed in a suitable location (REAC Ref. TB008).

8.5.44 Where artificial badger setts are required, these setts would be sited within the territories of the social groups where the main setts are being lost (see Appendix 8.19: Draft badger development licence application (confidential) (Application Document 6.3)).

8.5.45 Bat roosts that would be lost or heavily disturbed due to construction or operational activities would be removed under licence and alternative roosting structures would be provided in areas indicated on the Environmental Masterplan (see Figure 2.4: Environmental Masterplan (Application Document 6.2)) (REAC Ref. TB009). An air raid bunker within Shorne Woods containing a hibernation bat roost of brown long eared and Daubenton's bats, would be heavily disturbed as a result of the Project. A replica bunker would be constructed, prior to disturbance of the existing structure, within woodland habitat creation between Shorne Woods and Great Crabbles Wood at a location to be agreed with Natural England. The bunker would be constructed from brick

with blockwork covering, designed to provide similar internal temperatures and humidity levels to the existing air raid bunker. Internally there would be additional timber boarding approximately 150 x 75mm in size, on angles within the bunker allowing access behind them for bats. There would be 20 bat bricks installed in the internal walls (REAC Ref. TB027).

8.5.46 To reduce potential adverse effects on water vole during installation of the aggregate conveyor, footings would be carefully sited to avoid existing wetland habitat, within this area. Footings will be a minimum of 5m from bank tops. Any temporary crossings of ditches required during the conveyor's installation and decommissioning be managed using a Bailey bridge (or similar), which will be removed from site once installation is complete. The exact location of the footings and the bridge will be agreed with the Environmental Clerk of Works prior to installation (REAC Ref. TB023). Water vole translocation would take place in areas identified in the water vole licence application (Appendix 8.20: Draft water vole conservation licence application (Application Document 6.3)) (REAC Ref. TB016). The receptor site for these animals would be established through an offsite reintroduction project supported by the EWT, reintroducing water voles to catchments within Essex that have suffered from localised extinctions due to the presence of non-native mink *Neovison vison*, which predates on water vole, following the eradication of mink in this area (see the CoCP (Application Document 6.3, Appendix 2.2) and the Consents and Agreements Position Statement (Application Document 3.3)). The catchments that have been identified by the EWT are the Rivers Colne and Blackwater.

8.5.47 Barn owl breeding sites that would be lost due to construction would be removed while not in active use. Alternative breeding sites (nest boxes) would be provided >1.5km away from the Project boundary and other major roads, within an appropriate setting and in compliance with Shawyer (2011). The Project is working with EWT to provide a minimum of 12 artificial nest boxes to be installed in land managed by them. This would provide a replacement ratio of two artificial nest boxes for one lost site; the final number of boxes required would be informed by pre-construction surveys (see the CoCP (Application Document 6.3, Appendix 2.2) (REAC Ref. TB010) and the Consents and Agreements Position Statement (Application Document 3.3).

8.5.48 Barn owl breeding sites which would not require closure, but that may be subject to disturbance due to proximity to works, as identified in Figure 8.18 (Application Document 6.2), would be screened by acoustic fencing to prevent disturbance during the breeding season under the supervision of the ECoW (REAC Ref. TB011).

8.5.49 Bird nest boxes would be provided within areas of retained woodland and trees shown on Figure 2.4: Environmental Masterplan (Application Document 6.2), to supplement the habitat creation by compensating the loss of nesting opportunities whilst newly created habitats establish. A ratio of 10 assorted small nest boxes and one medium open-fronted nest box per hectare of lost woodland/scrub would be adopted in accordance with BTO Field Guide No. 23 (du Feu, 1993), where it is reasonably practicable to erect this number of nest boxes. For hedgerows, a ratio of 10 assorted small nest boxes per kilometre of hedgerow would be adopted, where it is reasonably practicable to erect these

numbers within retained vegetation. The measures would be implemented under the supervision of the ECoW (REAC Ref. TB012).

8.5.50 Where directional habitat clearance is not considered appropriate to avoid potential mortality of protected species, a programme of trapping and translocation would occur to move animals away from the construction site and to established receptor sites with sufficient carrying capacity prior to habitat clearance occurring. Species or groups which may be subject to trapping and translocation are GCN (and all other native amphibian species found during this process), reptiles, water voles and dormice (see Appendix 8.17: Draft EPS mitigation licence application – great crested newts; Appendix 8.18: Draft EPS mitigation licence application – dormouse; Appendix 8.20: Draft water vole conservation licence application; and the Appendix 2.2: CoCP (all Application Document 6.3) (REAC Ref. TB016)).

8.5.51 All required Natural England licences and associated working practices and method statements would be in place prior to any related construction works starting in areas where licensable species occur (REAC Ref. TB014).

8.5.52 Where protected species licences are relevant, these determine the approach to habitat clearance within specific locations (see Appendix 8.16: Draft EPS mitigation licence application - bats; Appendix 8.17: Draft EPS mitigation licence application – great crested newts; Appendix 8.18: Draft EPS mitigation licence application – dormouse; Appendix 8.19: Draft badger development licence application (confidential); Appendix 8.20: Draft water vole conservation licence application; and Appendix 2.2: CoCP (all Application Document 6.3)). Where protected species licences are not required, the approach to habitat clearance and the potential need to trap and translocate non-licensable species (reptiles and/or native amphibian species excluding GCN) to established receptor sites with sufficient carrying capacity would be determined and undertaken by the ECoW. Where translocation occurs, species will be only be translocated to receptor sites with established habitat (REAC Ref. TB017). Plans for the management of ecology developed in accordance with Requirement 4 of the draft DCO would ensure that site clearance and landscaping during construction would not conflict with the oLEMP (Application Document 6.7) (REAC Ref. TB026).

8.5.53 Habitat features of value to protected species that can themselves be moved to mitigation areas/receptor sites (for example dead-wood features for terrestrial invertebrates, and refuges for amphibians and reptiles) would be translocated where appropriate, to be determined by the ECoW (REAC Ref. TB018).

8.5.54 Monitoring of protected species during and post-construction would be in line with the requirements of the protected species mitigation licences (see Appendix 8.16: Draft EPS mitigation licence application - bats; Appendix 8.17: Draft EPS mitigation licence application – great crested newts; Appendix 8.18: Draft EPS mitigation licence application – dormouse; Appendix 8:19: Draft badger development licence application (confidential); Appendix 8.20: Draft water vole conservation licence application; and Appendix 2.2: the CoCP (all Application Document 6.3)) (REAC Ref. TB015).

8.5.55 Where important lichen species, *Usnea cf. esparantiana*, present within woodland south-west of the M25 junction 29, and *Physconia distorta* and

Fellhaneropsis vezdae, present within the Wilderness Woodland, are found on trees being felled or pruned to accommodate works, any timber hosting these species would be retained and moved immediately after felling into retained areas of the same woodland as shown on Figure 2.4: Environmental Masterplan (Application Document 6.2). Timber would be placed on the woodland floor immediately adjacent to a tree of the same host species. All works would be supervised by the ECoW (REAC Ref. TB020).

8.5.56 The soils from an area (approximately one hectare) of priority BAP acid grassland in Low Street Pit, as indicated on Figure 8.1 (Application Document 6.2), would be salvaged and moved to a suitable alternative site. The site is an area of grassland located between the sea wall and the Parish Church of St. Catherine (centred on Grid Reference TQ 69011 77146), approximately 100m to the north of Coalhouse Fort. This would be achieved by removing turf from the acid grassland and replanting it on the receptor site, shown on Figure 2.4: Environmental Masterplan (Application Document 6.2)) (REAC Ref. TB019).

Operational phase

8.5.57 Operational phase surveys for protected species would be informed by the requirements of the relevant protected species licence (see Appendix 8.16: Draft EPS mitigation licence application - bats; Appendix 8.17: Draft EPS mitigation licence application – great crested newts; Appendix 8.18: Draft EPS mitigation licence application – dormouse; Appendix 8:19: Draft badger development licence application (confidential); Appendix 8.20: Draft water vole conservation licence application (all Application Document 6.3)).

8.5.58 Measures to address the effect of air quality changes (increased nitrogen deposition), on designated habitats are detailed within the Project Air Quality Action Plan (Application Document 6.3, Appendix 5.6). These include specific mitigation measures to reduce nitrogen deposition through speed enforcement wherever appropriate along the strategic road network, compensatory planting of semi-natural habitat designed to provide large areas of wildlife-rich habitats that create new links and build resilience into the network of designated habitats.

Enhancement

8.5.59 The land parcel within/adjacent to the south of the Metropolitan Police firing range would be reinstated (after use as a construction compound) for habitat enhancement (Figure 2.4: Environmental Masterplan (Application Document 6.2). The land would be reinstated to create additional slow-flowing ditch, pond and grassland with scrub habitats for use by species such as water vole and GCN, as well as to provide suitable bird foraging and nesting habitat. These habitat enhancements have been agreed in principle with the RSPB, who are the landowners for this area (REAC Ref. TB022).

8.5.60 In addition to the water vole translocation and localised mink eradication as detailed in the essential mitigation section above, the Project is also committing to providing a wider conservation legacy benefit for water voles. The Project is to work in partnership with the EWT on the Waterlife Recovery East project with the aim to eradicate mink across an area of Norfolk and Suffolk spanning 5,500km^2.

8.5.61 Mink is an introduced, non-native species which predates heavily on water vole leading to local extinctions in areas of otherwise suitable water vole habitat. The Waterlife Recovery East project would provide long-term mink control within Norfolk, Suffolk, Lincolnshire, Cambridgeshire and Essex, opening up significant areas of water vole habitat for recolonisation by this species.

8.5.62 The financial support provided by the Project will achieve two goals. From the Project perspective, the mink control will free up habitat within Essex into which translocated water vole can be released, therefore providing part of the essential mitigation required for this species. At a regional scale, the Project support will help the EWT meet their objective of providing long-term conservation benefits for water vole across five counties, which is a substantially greater benefit than the Project could achieve working within the constraints of the Order Limits.

8.6 Assessment of likely significant effects

8.6.1 This section presents the assessment of predicted likely effects on terrestrial biodiversity receptors resulting from the construction and operational phases of the Project. This is based on the design of the Project and takes into account the mitigation as presented in Section 8.5.

8.6.2 The assessment considers the value/importance and impact magnitude criteria as presented in Table 8.5 and Table 8.6 respectively, and the significance of effects has been determined in accordance with the matrix provided in Table 8.7.

Construction phase

South of the River Thames

8.6.3 The likely effects of construction on ecological receptors include the following:

a. Habitat loss – direct loss of habitat as a result of construction
b. Direct mortality – construction activities causing direct mortality
c. Fragmentation/habitat severance – preventing animals dispersing and moving within the wider landscape
d. Habitat degradation – causing the habitat to become suboptimal, including air quality from dust and emissions from construction vehicles and hydrological impacts from dewatering or alteration to surface or ground water flows
e. Disturbance – noise, lighting and visual disturbance of species present, including from anthropomorphic influences

Statutory designated sites

8.6.4 The likely effects of construction on statutory designated sites include the following:

a. Habitat loss – for sites that are located or partly located within the Order Limits

b. Habitat degradation – direct and indirect impacts including deterioration in air quality from dust and emissions from construction vehicles, and hydrological impacts from dewatering or alteration to surface or ground water flows

c. Noise, light and visual disturbance of species present.

8.6.5 Habitat degradation and disturbance of species present within statutory designated sites from increased visitor pressure has been considered as part of the assessment of likely construction effects. Chapter 13: Population and Human Health includes a review of how construction might affect people using specific sites, including sites that are designated for their biodiversity importance. This demonstrates that numbers of recreational users will be likely to decrease as construction works commence and the ZoI becomes more difficult to access. It is likely that recreational users will disperse across a number of different sites as a result, with no sites being likely to experience significantly greater numbers of recreational users during construction, whereby likely significant effects on the biodiversity resource would occur. Furthermore, impacts from 'construction tourism', whereby additional visitors are attracted to the ZoI to view the construction area are not considered likely to result in significant effects on terrestrial biodiversity. This is because the Project comprises a long linear scheme and, therefore, there is unlikely to be a single focus point within the ZoI that creates a specific visitor attraction. This is considered further in Chapter 13: Population and Human Health.

8.6.6 An assessment of the likely significant effects on individual statutory designated sites is considered further below.

Cobham Woods SSSI and ancient woodland

8.6.7 No direct impacts on the site are anticipated as a result of the Project on Cobham Woods SSSI (which also includes Great Wood ASNW). Cobham Woods is located approximately 331m south of the Order Limits and Great Wood is 23m (outside of the SSSI boundary) from the Order Limits.

8.6.8 **Habitat degradation**: Indirect impacts such as increased dust deposition, emissions from construction vehicles and Non-road Mobile Machinery or accidental pollution events during construction are unlikely, given the SSSI is approximately 331m from the Order Limits. The inclusion of the good practice measures as outlined in the CoCP (Application Document 6.3, ES Appendix 2.2) and described in Section 8.5 and Section 5.5 of Chapter 5: Air Quality, would also avoid likely impacts on Great Wood ASNW, which is located approximately 20m from the Order Limits. The SSSI and ancient woodland are of national importance, however it is considered there would be no change to the habitats within the sites, and effects would therefore be neutral and **not significant**.

Shorne and Ashenbank Woods SSSI

8.6.9 **Habitat loss:** The widening of the A2, along with the unavoidable utilities diversions and the construction of green bridges in this area, would lead to a permanent loss of 5.85ha (2.9%) of habitat within Shorne and Ashenbank Woods SSSI, of which 0.95ha (0.9%) is designated ancient woodland within Shorne and Brewers Woods SSSI. Non-woodland habitat from between the

A2/M2 and High Speed 1 (HS1) including landscape planting would be lost from south of the A2/M2. The loss of SSSI habitat would be compensated with woodland planting which would be contiguous with the SSSI, specifically a 5ha block of planting to the north-west of Shorne Woods, located 200m to the east of the route alignment. A second block of 9.1ha is immediately to the north of Shorne Woods, located at over 900m from the route alignment. The third 21ha block of woodland planting is to the east of Shorne Woods, immediately to the north of the A2/M2, which would provide a strong connection between Shorne and Ashenbank Woods SSSI and Great Crabbles Wood SSSI (refer to Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.15, LSP.19, S1.08, S1.14, and S2.01). This new woodland planting would be in accordance with adjacent woodland habitat, which is assigned as NVC community W10 *Quercus robur – Pteridium aquilinum – Rubus fructicosus* woodland. This planting would increase the area of woodland immediately adjacent to the SSSI and would, as it established, provide habitat for species associated with the SSSI. The two new green bridges along Thong Lane and Brewers Lane which cross the A2 and HS1 would provide green links between Shorne Wood and Ashenbank Wood, which currently do not exist.

8.6.10 The new links between retained woodland habitat would increase the resilience of the network in this local area, not just between the two separate woodlands of Shorne and Ashenbank, but also the SSSI and Great Crabbles Wood SSSI, and further south and east as these sites link into other SSSIs including Cobham Woods SSSI, Halling to Trottiscliffe Escarpment SSSI, and Wouldham to Detling Escarpment SSSI. Like Shorne and Ashenbank Woods SSSI, these sites all include woodland habitat, much of which is designated ancient woodland. Additional woodland planting designed to compensate the loss of ancient woodland, rather than as specific SSSI compensation, would provide further connectivity between Shorne Woods and Claylane Wood to the west, again adding resilience to the wider woodland landscape.

8.6.11 SSSIs are sites of national importance for biodiversity. An irreversible minor permanent adverse level of impact is predicted as, although there is a direct loss of habitat from Shorne and Ashenbank Woods SSSI, the loss is relatively small compared to the overall area of the SSSI and affected land along the edges already in close proximity to the A2. With the relatively large area of proposed compensatory planting in comparison with the amount of habitat being lost, and the location of the compensatory planting to connect existing areas of ancient woodland, the impact of habitat loss is not considered likely to affect the site's overall integrity. This would result in a moderate adverse effect that is **significant**.

8.6.12 **Disturbance of species:** Survey work has confirmed the presence of breeding birds and rare invertebrate species, both being reasons for the site's notification. The predicted construction effects on each of these features are discussed in more detail in the relevant species sections below. Project design and mitigation measures are detailed in the CoCP (Application Document 6.3, ES Appendix 2.2) and outlined in Section 8.5. These include fencing, appropriate timing of works, appropriate lighting designs, phased vegetation clearance, ECoW supervision, as well as habitat creation. Following the implementation of these, the overall impact on the integrity and conservation

status of the SSSI from the potential disturbance to the species for which the site is designated, would be reversible temporary negligible adverse, resulting in slight adverse effects that are **not significant**.

8.6.13 **Habitat degradation**: Increased dust deposition during the construction phase can potentially have negative effects. However, the inclusion of the good practice measures as outlined in the CoCP (Application Document 6.3, ES Appendix 2.2) and described in Section 8.5 and Section 5.5 of Chapter 5: Air Quality, is expected to avoid likely impacts on Shorne and Ashenbank Woods SSSI, resulting in an effect which is neutral and **not significant**.

8.6.14 The proposed habitat creation associated with the woodland planting connecting Great Crabbles Wood SSSI and Shorne Woods would increase the extent of this habitat type in the local area (see Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.15, LSP.19, S1.08, S1.14, and S2.01). This would help to protect the resilience of Shorne and Ashenbank Woods SSSI and provide connectivity for species, further safeguarding the integrity and conservation status of the SSSI. This biodiversity resource is of national importance, and a minor permanent improvement is predicted, resulting in a slight beneficial effect that is **not significant**.

Great Crabbles Wood SSSI

8.6.15 No direct impacts on Great Crabbles Wood SSSI and ancient woodland, are anticipated as a result of construction of the Project. No animal species are a reason for notification for Great Crabbles Wood SSSI, so disturbance of species is scoped out. The SSSI lies immediately adjacent to the Order Limits.

8.6.16 **Habitat degradation:** Indirect impacts such as increased dust deposition, emissions from construction vehicles and Non-road Mobile Machinery or accidental pollution events are unlikely following the implementation of embedded mitigation measures (e.g. dust suppression and control of runoff) to manage such impacts as detailed in the CoCP (Application Document 6.3, ES Appendix 2.2) and described in Section 8.5, and Section 5.5 of Chapter 5: Air Quality. These measures are expected to avoid likely impacts, resulting in an effect which is neutral and **not significant**.

8.6.17 The proposed habitat creation associated with the woodland planting connecting Great Crabbles Wood SSSI and Shorne Woods would increase the extent of this habitat type in the local area (see Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.15, LSP.19, S1.08, S1.14 and S2.01). This would help to protect the resilience of the woodland and provide connectivity for species, further safeguarding the integrity and conservation status of Great Crabbles Wood SSSI. This biodiversity resource is of national importance, and a minor permanent improvement is predicted, resulting in a slight beneficial effect that is **not significant**.

South Thames Estuary and Marshes SSSI

8.6.18 **Habitat loss**: South Thames Estuary and Marshes SSSI lies partially within the Order Limits, but north of the South Portal. No habitat loss within the site would occur as a result of the Project due to tunnelling operations taking place

beneath this designated site. The effect would therefore be neutral and **not significant**.

8.6.19 **Habitat degradation:** Increased dust deposition and changes in water quality/ quantity within surface waters during the construction phase would potentially result in a negative effect on the grazing marsh, saltmarsh, dykes and fleets, and mudflats for which the SSSI is designated. However, increased dust deposition, emissions from construction vehicles and Non-road Mobile Machinery and accidental pollution events are unlikely following the implementation of good practice mitigation measures (e.g. dust suppression, control and treatment of runoff) to manage such impacts as detailed in the CoCP (Application Document 6.3, ES Appendix 2.2) and described in Section 8.5, and Section 5.5 of Chapter 5: Air Quality.

8.6.20 In order to effectively treat the water to meet discharge consent standards within the southern tunnel entrance compound, a full collection and management regime would be implemented and be in operation on the site until full reinstatement of the compound area is complete.

8.6.21 A series of ponds/lagoons and weirs would be constructed within the Order Limits to serve three purposes:

a. Provide a volume of storage for attenuation

b. Encourage gravitational settlement of solid fraction

c. Offer a degree of re-infiltration into the chalk ground

8.6.22 The treated water from the final lagoon in southern tunnel entrance compound would be pumped into the ditch network which forms part of the Thames Estuary and Marshes Ramsar site. The flow would be regulated to ensure the discharge flow rates are managed at greenfield runoff rates.

8.6.23 Construction of the main tunnels associated with the Project and the ground protection tunnel has the potential to lead to reduced water levels within the ditch system associated with the designated site, and therefore negatively impact flora and fauna through loss of wetted area. However, groundwater level data from boreholes within the Ramsar site indicates that there is insufficient hydraulic head difference to drive net flow from the study area to the lower strata, meaning a hydrological connection is unlikely and therefore an effect from reduced water levels is not anticipated (see Appendix 14.5 (Application Document 6.3)). Overall, it is considered there will be no change to the South Thames Estuary and Marshes SSSI, with the effect therefore being neutral and **not significant**.

8.6.24 **Disturbance of species present:** As well as its notable habitats, the SSSI is designated for supporting a large number of feeding waders and wildfowl, a large number of breeding birds as well as diverse invertebrate fauna. The possible construction effects on each of these ecological features are discussed in the relevant sections below (refer to paragraphs 8.6.69 to 8.6.79 and 8.6.114 to 8.6.129).

8.6.25 Construction-related activities would result in an increase in noise levels that could cause disturbance to species in the surrounding area, potentially including non-breeding birds. The additional noise would likely be irregular in nature,

however there is already a high level of irregular background noise from the existing railway line and Metropolitan Police firing range. In addition, most sources of increased noise levels arising from above-ground works would be in excess of 850m from the habitats located adjacent to the River Thames, with a small area of construction immediately adjacent to the northern edge of Filborough Marshes. The addition of this construction noise is therefore unlikely to cause significant disturbance. Visual disturbance would be likely to affect species by causing them to avoid areas of habitat that might otherwise be used for foraging and resting. Implementation of the good practice measures described in Section 8.5, includes the use of screening where necessary to safeguard any particularly sensitive areas. Following the implementation of these, the overall impact on the integrity and conservation status of the SSSI from the potential disturbance to the species for which the site is designated, would be reversible temporary negligible adverse, resulting in slight adverse effects that are **not significant**.

Halling to Trottiscliffe Escarpment SSSI

8.6.26 No direct impacts on Halling to Trottiscliffe Escarpment SSSI are anticipated during the construction phase, as the site is located approximately 1.5km from the Order Limits.

8.6.27 **Habitat degradation:** Indirect impacts such as increased dust deposition, accidental pollution events and emissions from construction vehicles and Non-road Mobile Machinery are not predicted, given the distance between this designated site and the required construction works. There would be no change to the site, and the effects of the Project on this site would therefore be neutral and **not significant**.

Wouldham to Detling Escarpment SSSI

8.6.28 No direct impacts on Wouldham to Detling Escarpment SSSI and ancient woodland, are anticipated as a result of construction of the Project. No animal species are a reason for notification for Wouldham to Detling Escarpment SSSI, so disturbance of species is scoped out. The SSSI lies immediately adjacent to the Order Limits.

8.6.29 **Habitat degradation:** Indirect impacts such as increased dust deposition, emissions from construction vehicles and Non-road Mobile Machinery or accidental pollution events are unlikely following the implementation of embedded mitigation measures (e.g. dust suppression and control of runoff) to manage such impacts as detailed in the CoCP (Application Document 6.3, ES Appendix 2.2) and described in Section 8.5, and Section 5.5 of Chapter 5: Air Quality. These measures are expected to lead to no change, resulting in an effect which is neutral and **not significant**.

8.6.30 The proposed habitat creation associated with the woodland planting adjacent to Wouldham to Detling Escarpment SSSI would increase the extent of this habitat type in the local area (see Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.15, LSP.19, S1.08, S1.14 and S2.01). This would help to protect the resilience of the woodland and provide connectivity for species, further safeguarding the integrity and conservation status of Wouldham to Detling Escarpment SSSI. This biodiversity resource is of national importance,

and a permanent minor improvement is predicted, resulting in a slight beneficial effect that is **not significant**.

8.6.31 **Disturbance of species present**: The site is designated for supporting a diverse invertebrate fauna. The possible construction effects on terrestrial invertebrates are discussed in the terrestrial invertebrate section below. Temporary disturbance impacts to invertebrates from the habitat creation adjacent to the SSSI are predicted, however they would only be of a temporary nature. The level of impact on the SSSI, which is of national importance, would be reversible temporary negligible adverse, resulting in effects that are slight adverse and **not significant**. The conservation status of these species and the integrity of the SSSI would therefore be maintained as a result of the Project.

Peter's Pit SAC and SSSI

8.6.32 No direct impacts on Peter's Pit SAC and SSSI are anticipated during the construction phase, as the site is located approximately 1.75km from the Order Limits.

8.6.33 **Habitat degradation:** Indirect impacts such as increased dust deposition, accidental pollution events and emissions from construction vehicles and Non-road Mobile Machinery are not predicted, given the distance between this designated site and the required construction works. There would be no change to the site, and the effects of the Project on this site would therefore be neutral and **not significant**.

Holborough to Burnham Marshes SSSI

8.6.34 No direct impacts on Holborough to Burnham Marshes SSSI are anticipated during the construction phase, as the site is located approximately 1.5km from the Order Limits.

8.6.35 **Habitat degradation:** Indirect impacts such as increased dust deposition, accidental pollution events and emissions from construction vehicles and Non-road Mobile Machinery are not predicted, given the distance between this designated site and the required construction works. There would be no change to the site, and the effects of the Project on this site would therefore be neutral and **not significant**.

Rede Common LNR

8.6.36 No direct impacts on Rede Common LNR are anticipated during the construction phase, as the site is located over 1km from the Order Limits.

8.6.37 **Habitat degradation:** Indirect impacts such as increased dust deposition, accidental pollution events and emissions from construction vehicles and Non-road Mobile Machinery are not predicted, given the distance between this designated site and the required construction works. There would be no change to the site, and the effects of the Project would therefore be neutral and **not significant**.

Swanscombe Peninsula SSSI

8.6.38 No direct impacts on Swanscombe Peninsula SSSI are predicted during the construction phase, as the site is located 670m from the Order Limits.

8.6.39 **Habitat degradation:** Indirect impacts such as increased dust deposition, accidental pollution events, and emissions from construction vehicles and Non-road Mobile Machinery are not predicted, given the distance between this designated site and the required construction works. There would be no change to the site, and the effects of the Project would therefore be neutral and **not significant**.

North Downs Woodlands SAC

8.6.40 No direct impacts on North Down Woodlands SAC, are anticipated as a result of construction of the Project. No animal species are a reason for notification for North Down Woodlands SAC, so disturbance of species is scoped out. The SAC lies immediately adjacent to the Order Limits.

8.6.41 **Habitat degradation**: Indirect impacts such as increased dust deposition, emissions from construction vehicles and Non-road Mobile Machinery or accidental pollution events are unlikely following the implementation of embedded mitigation measures (e.g. dust suppression and control of runoff) to manage such impacts as detailed in the CoCP (Application Document 6.3, ES Appendix 2.2) and described in Section 8.5, and Section 5.5 of Chapter 5: Air Quality. These measures are expected to lead to no change, resulting in an effect which is neutral and **not significant**.

8.6.42 The proposed habitat creation associated with the woodland planting connecting adjacent areas to the North Down Woodlands SAC would increase the extent of this habitat type in the local area (see Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.15, LSP.19, S1.08, S1.14 and S2.01). This would help to protect the resilience of the woodland and provide connectivity for species, further safeguarding the integrity and conservation status of the North Down Woodlands SAC. This biodiversity resource is of international importance, and a permanent minor improvement is predicted, resulting in a slight beneficial effect that is **not significant**.

Boxley Warren LNR

8.6.43 No direct impacts on Boxley Warren LNR, are anticipated as a result of construction of the Project. The LNR lies immediately adjacent to the Order Limits.

8.6.44 **Disturbance of species present**: The site is noted for supporting a diverse fauna. The possible construction effects on species are discussed in the individual species sections below. Disturbance impacts to species from the habitat creation adjacent to the LNR are predicted, however they would only be of a temporary nature. The level of impact on the LNR, which is of national importance, would be reversible temporary negligible adverse, resulting in effects that are slight adverse and **not significant**. The conservation status of these species and the integrity of the LNR would therefore be maintained as a result of the Project.

8.6.45 **Habitat degradation:** Indirect impacts such as increased dust deposition, emissions from construction vehicles and Non-road Mobile Machinery or accidental pollution events are unlikely following the implementation of embedded mitigation measures (e.g. dust suppression and control of runoff) to manage such impacts as detailed in the CoCP (Application Document 6.3, ES Appendix 2.2) and described in Section 8.5, and Section 5.5 of Chapter 5: Air Quality. These measures are expected to lead to no change, resulting in an effect which is neutral and **not significant**.

8.6.46 The proposed habitat creation associated with the woodland planting connecting adjacent to the Boxley Warren LNR would increase the extent of this habitat type in the local area (see Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.15, LSP.19, S1.08, S1.14 and S2.01). This would help to protect the resilience of the woodland and provide connectivity for species, further safeguarding the integrity and conservation status of Boxley Warren LNR. This biodiversity resource is of national importance, and a permanent minor improvement is predicted, resulting in a slight beneficial effect that is **not significant**.

Nitrogen deposition impacts

8.6.47 There is potential for effects associated with increased nitrogen deposition on designated habitats within close proximity to the construction ARN from traffic emissions (see Section 5.5 of Chapter 5: Air Quality. These are detailed in Appendix 8.14: Designated Sites Air Quality Assessment (Application Document 6.3), which considers the effects of nitrogen deposition on designated sites that require further consideration in line with DMRB LA 105 Air Quality (Highways England, 2020b). DMRB LA 105 Air Quality states that if construction activity is less than two years then it is unlikely that they would constitute a significant air quality effect. As the Project's construction period exceeds two years, construction effects have been assessed. No statutory sites were identified for further consideration, but seven non-statutory sites were screened in for assessment. A summary table of the conclusions of Appendix 8.14 (Application Document 6.3) is presented in Table 8.29 below. Where sites are affected by both construction and operational increases in nitrogen deposition, these are addressed in the operational assessment section of this chapter and have been highlighted accordingly. This is to take into account the cumulative durational effect of sites experiencing increased nitrogen deposition during both the construction and operational phase of the assessment.

Non-statutory designated sites

8.6.48 A total of 23 non-statutory designated sites are located within 500m of the Order Limits to the south of the River Thames. The likely effects associated with the construction phase are provided in Table 8.29. They include the following:

a. Habitat loss – for sites that are located or partly located within the Order Limits

b. Habitat degradation – direct and indirect effects including air quality and hydrology

c. Noise and visual disturbance of species present – for sites that are located or partly located within the Order Limits (with the exception of mobile species like birds or bats where these are a designated feature)

8.6.49 Project design and mitigation measures outlined in Section 8.5 would safeguard sites listed in Table 8.29 with no direct impacts, from likely indirect effects during construction. This includes measures to reduce potential pollution due to runoff and air quality effects associated with construction dust, as well as emissions from construction vehicles and Non-road Mobile Machinery.

8.6.50 Habitat degradation and disturbance of species present within non-statutory designated sites from increased visitor pressure, has been considered as part of the assessment of likely construction effects. The same conclusions are drawn as outlined above in paragraph 8.6.5 for statutory designated sites, with reference to Chapter 13: Population and Human Health (Application Document 6.1), where further consideration is given to the likely changes in the activity of recreational users within the ZoI. Therefore, likely significant effects on the biodiversity resources within non-statutory designated sites would not occur during construction as a result of increased visitor pressure.

Table 8.29 Construction phase effects on LWSs and ancient woodland not underpinning statutory sites south of the River Thames

Designated site	Impacts, mitigation and overall likely effects
Jeskyns LWS	None – the LWS is located over 302m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the LWS from likely indirect effects during construction. There would be no change to the site, and the effect of the Project would therefore be neutral and **not significant**.
Area of ancient woodland around A2/M2 junction 1	None – no construction works are proposed within this ancient woodland parcel, which is immediately adjacent to the Order Limits. Good practice mitigation including temporary fencing, dust suppression and surface water pollution runoff treatment identified in Section 8.5 would safeguard the ASNW from likely indirect effects during construction. This would result in a temporary negligible adverse level of impact, that would result in an effect that is slight adverse and **not significant**.
Claylane Wood ASNW	Habitat loss (4.24ha representing 48% of the ASNW) due to the new A122 Lower Thames Crossing alignment joining the A2 at the south-east corner of Claylane Wood and the site therefore lying partially within the Order Limits. Given its status as ancient woodland, any habitat lost is considered to be irreplaceable. Habitat degradation due to possible pollution events and disturbance to dormice, badgers and nesting birds present would be mitigated by the good practice mitigation identified in Section 8.5. This mitigation would include temporary fencing of retained habitats, translocation of protected species to suitable retained habitats and newly created receptor sites that can accommodate such species (refer to (Figure 2.4: Environmental Masterplan (Application Document 6.2)) and nesting bird checks carried out by an ECoW. This mitigation would reduce the likely impacts such that the conservation status of the species associated with the designated site would be maintained.

Designated site	Impacts, mitigation and overall likely effects
	Compensatory woodland planting would also be provided to compensate, in part, for the loss of this habitat. This woodland habitat creation would be immediately to the north of Claylane Wood ASNW, with the new woodland planting connecting Shorne and Ashenbank SSSI over the Thong Lane north green bridge (see Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.15, LSP.19, S1.08, S1.14 and S2.01). However, the loss of ancient woodland, which is assessed to be of national importance, would be a permanent major adverse level of impact that would adversely affect the integrity of the site. This would result in an effect that is large adverse and **significant**.
Shorne Pasture LWS	None – the LWS is located over 258m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the LWS from likely indirect effects during construction. There would be no change to the site, and the effect of the Project would therefore be neutral and **not significant**.
Court Wood LWS, Starmore Wood ASNW and Peartree Wood ASNW	None – no construction works are proposed within the LWS or ASNW, both of which are immediately adjacent to the Order Limits. Construction in this area is limited to habitat creation, particularly for woodland planting which will connect up areas of the existing woodland (refer to (Figure 2.4: Environmental Masterplan (Application Document 6.2)). Good practice mitigation identified in Section 8.5 including temporary fencing of important habitats, dust suppression measures, safeguarding the Root Protection Areas of retained trees and surface water runoff treatment would safeguard the LWS or ASNW from likely indirect effects during construction. This would result in a temporary negligible adverse level of impact, that would result in an impact that is slight adverse and **not significant**. This effect would eventually become slight beneficial in the long term, with the establishment of the new woodland planting.
Telegraph Hill LWS	None – no construction works are proposed within the LWS which is 348m away from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the LWS from likely indirect effects during construction. There would be no change to the site, and the effect of the Project would therefore be neutral and **not significant**.
Chilton Hills Wood ASNW	None – no construction works are proposed within the woodland which is 388m away from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the woodland from likely indirect effects during construction. There would be no change to the site, and the effect of the Project on this ASNW would therefore be neutral and **not significant**.
Ebbsfleet Marshes LWS	None – no construction works are proposed within the LWS which is 499m away from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the LWS from likely indirect effects during construction. There would be no change to the site, and the effect of the Project would therefore be neutral and **not significant**.

Designated site	Impacts, mitigation and overall likely effects
A226 Gravesend RNR	None – no construction works are proposed within the RNR. Habitat degradation due to possible pollution events could occur. Good practice mitigation including temporary fencing of retained habitats, dust suppression and surface water runoff treatment as detailed in Section 8.5 would avoid the adverse impacts on the RNR. There would be no change to the site, and the effect of the Project would therefore be neutral and **not significant**.
A227/A20 London Road RNR	None – the RNR is located over 428m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the RNR from likely indirect effects during construction. There would be no change to the site, and the effect of the Project would therefore be neutral and **not significant**.
Canal and Grazing Marsh Higham LWS	Habitat loss (4.17ha representing 7% of the LWS) due to the construction of a temporary construction compound. The habitat to be lost primarily comprises scrub and ruderal vegetation adjacent to Wharf Road. One watercourse within this LWS will be diverted temporarily during construction, and some work will be carried out on the north bank of the Thames and Medway Canal within the LWS. This habitat will be reinstated after construction, with the addition of a number of wetland features which will improve the LWS. Construction of the main tunnels associated with the Project and the ground protection tunnel has the potential to lead to reduced water levels within the ditch system associated with the LWS and therefore negatively impact macrophytes through loss of wetted area. However, groundwater level data from boreholes within the site indicates that there is insufficient hydraulic head difference to drive net flow from the study area to the lower strata, meaning a hydrological connection is unlikely and therefore an effect from reduced water levels is not anticipated (see Appendix 14.5 (Application Document 6.3)). Good practice mitigation including temporary fencing of retained habitats, dust suppression and surface water runoff treatment as detailed in Section 8.5 would also safeguard the LWS from likely indirect effects during construction. The site is of county importance, and the level of impact on the site is predicted to be reversible temporary moderate adverse, resulting in a slight adverse effect which is **not significant**.
Blue Bell Hill Banks and Verges LWS	None – the LWS is located over 105m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the LWS from likely indirect effects during construction. There would be no change to the site, and the effect of the Project would therefore be neutral and **not significant**.
Walderslade Woods LWS	None – the LWS is located over 216m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the LWS from likely indirect effects during construction. There would be no change to the site, and the effect of the Project would therefore be neutral and **not significant**.
Frith Woods ASNW, Kits Coty LWS	None – no construction works are proposed within the ASNW and LWS which is immediately adjacent to the Order Limits. Construction in this

Designated site	Impacts, mitigation and overall likely effects
	area is limited to habitat creation, particularly for woodland planting which will connect up areas of existing woodland (refer to (Figure 2.4: Environmental Masterplan (Application Document 6.2)). Good practice mitigation identified in Section 8.5 including temporary fencing of important habitats, dust suppression measures, safeguarding the Root Protection Areas of retained trees and surface water runoff treatment would safeguard the LWS from likely indirect effects during construction. This would result in a reversible temporary negligible adverse level of impact, that would result in an impact that is slight adverse and **not significant**. This effect would eventually become slight beneficial in the long term, with the establishment of the new woodland planting.
Frith/Impton Woods ASNW	None – no construction works are proposed within the ASNW which is immediately adjacent to the Order Limits. Construction in this area is limited to habitat creation, particularly for woodland planting which will connect up areas of existing woodland (refer to (Figure 2.4: Environmental Masterplan (Application Document 6.2)). Good practice mitigation identified in Section 8.5 including temporary fencing of important habitats, dust suppression measures, safeguarding the Root Protection Areas of retained trees and surface water runoff treatment would safeguard the ASNW from likely indirect effects during construction. This would result in a reversible temporary negligible adverse level of impact, that would result in an impact that is slight adverse and **not significant**. This effect would eventually become slight beneficial in the long term, with the establishment of the new woodland planting.
B2015 Branbridges Road RNR	None – the RNR is located over 495m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the RNR from likely indirect effects during construction. There would be no change to the site, and the effect of the Project would therefore be neutral and **not significant**.
Impton/Podkin Wood ASNW	None – no construction works are proposed within the ASNW which is immediately adjacent to the Order Limits. Construction in this area is limited to habitat creation, particularly for woodland planting which will connect up areas of existing woodland (refer to (Figure 2.4: Environmental Masterplan (Application Document 6.2)). Good practice mitigation identified in Section 8.5 including temporary fencing of important habitats, dust suppression measures, safeguarding the Root Protection Areas of retained trees and surface water runoff treatment would safeguard the ASNW from likely indirect effects during construction. This would result in a reversible temporary negligible adverse level of impact, that would result in an impact that is slight adverse and **not significant**. This effect would eventually become slight beneficial in the long term, with the establishment of the new woodland planting.
Warren Road RNR	None – the RNR is located over 254m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the RNR from likely indirect effects during construction. There would be no change to the site, and the effect of the Project would therefore be neutral and **not significant**.

Designated site	Impacts, mitigation and overall likely effects
Westfield Wood ASNW	None – no construction works are proposed within the ASNW which is immediately adjacent to the Order Limits. Construction in this area is limited to habitat creation, particularly for woodland planting which will connect up areas of existing woodland (refer to (Figure 2.4: Environmental Masterplan (Application Document 6.2)). Good practice mitigation identified in Section 8.5 including temporary fencing of important habitats, dust suppression measures, safeguarding the Root Protection Areas of retained trees and surface water runoff treatment would safeguard the ASNW from likely indirect effects during construction. This would result in a reversible temporary negligible adverse level of impact, that would result in an impact that is slight adverse and **not significant**. This effect would eventually become slight beneficial in the long term, with the establishment of the new woodland planting.
M26/A20 London Road Roundabout RNR	None – the RNR is located 451m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the RNR from likely indirect effects during construction. There would be no change to the site, and the effect of the Project would therefore be neutral and **not significant**.
Burham Down ASNW	None – the ASNW is located over 357m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the ASNW from likely indirect effects during construction. There would be no change to the site, and the effect of the Project would therefore be neutral and **not significant**.

Table 8.30 Non-statutory designated habitats south of the River Thames – air quality impact summary

Designated site	Importance	Level of impact	Effect
AW_Theme_ID1487077 AW	National	Negligible adverse	Slight adverse **Not significant**
AW_Theme_ID1487086 AW	National	No change	Neutral **Not significant**
AW_Theme_ID1487106 AW	National	Negligible adverse	Slight adverse **Not significant**
Straight Path Shaw LWS	County	Negligible adverse	Neutral **Not significant**
803_VT	National	Negligible adverse	Slight adverse **Not significant**
804_VT	National	Negligible adverse	Slight adverse **Not significant**
805_VT	National	Negligible adverse	Slight adverse **Not significant**

Plants and habitats

8.6.51 The likely effects on habitats associated with the construction phase would be:

a. Habitat loss

b. Habitat degradation

8.6.52 **Habitat loss**: The construction phase of the Project would result in habitat losses and gains of both a temporary and permanent nature. Permanent gains are classified as habitat created in the land owned by National Highways and where habitat has been reinstated or created to compensate for the predicted losses. Table 8.31 shows all the predicted habitat losses and gains associated with the Project, including habitats which are within designated sites. The losses and gains associated with habitats that are considered to be of local importance or higher and therefore requiring further assessment, are then further discussed (see paragraphs 8.6.53 to 8.6.68).

Table 8.31 Habitat losses and gains associated with the Project to the south of the River Thames

Existing habitat	Importance	Habitat loss (ha)	New semi-natural habitat (from Environmental Masterplan)	Habitat permanent gain	Net permanent gain (gain–loss)
Ancient woodland	National	5.35ha	Ancient Woodland Compensation Planting (LE8.2)	48.75ha	43.40ha (Not considered a net gain due to the irreplaceable nature of the habitat lost)
Ancient and veteran trees	National	Three veteran trees lost. No loss of ancient trees. See Figure 8.2 (Application Document 6.2) for locations.	Scattered trees (LE2.7) and individual trees (LE5.1)	0.05ha	0.05ha (Not considered a net gain due to the irreplaceable nature of the habitat lost)
Semi-natural broadleaved woodland	County	7.03ha	Native woodland (LE2.1), woodland with non-native species (LE2.11), woodland edge (LE2.2), linear belt of shrubs and trees (LE2.4)	104.23ha	62.34ha
Plantation woodland	County	34.86ha			
Scrub	County	4.39ha	Scrub (LE2.8), shrubs with intermittent trees (LE2.5)	11.23ha	6.84ha
Scattered and parkland trees	Local	Not calculated, see Figure 8.2 (Application Document 6.2) for locations	See scattered trees (LE2.7) and individual trees (LE5.1) above	–	–
Neutral grassland	County (BAP habitat)	9.87ha	Species-rich grassland (LE1.3) and annual wildflower grassland (LE1.32)	120.62ha	100.55ha
	Local	10.2ha			
Calcareous grassland	County	2.73ha	Species-rich chalk grassland (LE1.31)	30.78ha	28.05ha

Existing habitat	Importance	Habitat loss (ha)	New semi-natural habitat (from Environmental Masterplan)	Habitat permanent gain	Net permanent gain (gain–loss)
Improved grassland	Local	20.62ha	Reinstated only	3.24ha	-17.38ha
Marshy grassland	County	0ha	Wet grassland (LE6.4)	8.37ha	8.37ha
Species-poor semi-improved grassland	Local	60.77ha	Reinstated only	18.85ha	-41.92ha
Continuous bracken	No appreciable importance	0.03ha	Reinstated only	0.01ha	-0.02ha
Tall ruderal herbs	No appreciable importance	5ha	Reinstated only	1.45ha	-3.55ha
Swamp and marginal vegetation	County	0.35ha	Reinstated only	0.17ha	-0.18ha
Standing water (ponds)	County	0.36ha	Water bodies – standing water (LE6.11), ecology pond (LE8.5)	3.54ha	3.18ha
Standing water (lakes and reservoirs)	County	0ha			
Coastal (see Section 9.7 of Chapter 9: Marine Biodiversity for more details)	National	0ha	Reinstated only	0ha	0ha

Existing habitat	Importance	Habitat loss (ha)	New semi-natural habitat (from Environmental Masterplan)	Habitat permanent gain	Net permanent gain (gain–loss)
Arable	Local	305.73ha	Reinstated only	110.65ha	-195.08ha
Amenity grassland	No appreciable importance	37.31ha	Reinstated only	6.59ha	-30.72ha
Ephemeral/ short Perennial	Local	0.87ha	Rock and scree (LE1.4), green roof (LE7.2)	0.11ha	-0.76ha
Open mosaic habitat	National	4.43ha	Open mosaic habitat (LE8.1)	13.86ha	9.43ha
Coastal and floodplain grazing marsh	National	0.36ha	Marsh and wet grassland – coastal grazing marsh (LE6.41)	2.48ha	2.12ha
Other habitats	No appreciable importance	69.75ha	Reinstated only	94.71ha	24.96ha
Existing linear habitats	**Importance**	**Habitat loss length (km)**	**New habitat (from EMP)**	**Habitat permanent gain (km)**	**Net permanent gain (km) (gain – loss)**
Hedgerow – native species-rich	County	1.16km	Native species hedgerow untrimmed (LE4.3) and native hedgerow with trees (LE4.4)	11.32km	6.48km
Hedgerow – native species-poor		1.99km			
Defunct hedgerow – native species-rich		0.01km			

Existing habitat	Importance	Habitat loss (ha)	New semi-natural habitat (from Environmental Masterplan)	Habitat permanent gain	Net permanent gain (gain–loss)
Defunct hedgerow – native species-poor		1.04km			
Hedgerow – native species-rich with trees		0.48km			
Hedgerow – native species-poor with trees		0.16km			
Standing water (canal)	County	0km	Reinstated only	0km	0km
Standing water (ditches)	Local	0.83km	Reinstated only	0.83km	0km
Running water (rivers and streams)	County	0km	Reinstated only	0km	0km

Ancient woodland

8.6.53 The Project would result in the irreversible loss of 5.35ha of ancient woodland to the south of the River Thames. To compensate for the loss of this woodland, 48.75ha of woodland planting would be created (Table 8.31). Further details of this habitat creation are provided in Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.15, LSP.19, S1.08, S1.14 and S2.01. The design of this planting is intended to not only compensate the direct loss of woodland habitat but also add resilience to the wider network of ancient woodland sites within the area through strengthening green corridors between retained woodland habitat. The full extent of habitat loss and assessment of impacts as a result of the Project on areas of ancient woodland within the study area are considered in detail for each individual ancient woodland in the designated sites section, above (refer to Table 8.29 and Table 8.31). See Figure 8.33 (Application Document 6.2) for locations of ancient woodland impacts and compensation areas.

Ancient and veteran trees

8.6.54 Of the ancient and veteran trees to the south of the River Thames, three are to be permanently removed (T41, T133 and T145). The trees to be removed are veteran trees, and no ancient trees are likely to be adversely impacted. Further details regarding this assessment are provided in compensate, in part, for the loss of these trees through the planting of additional trees, retaining suitable dead wood material within the retained areas of ancient woodland and habitat creation areas within the Order Limits (to provide habitat features for other receptors such as terrestrial invertebrates) (see CoCP (Application Document: 6.3, ES Appendix 2.2), REAC Ref. TB018, LV031, LV032) and targeted veteranisation pruning during construction of suitable retained trees within the Order Limits. However, ancient and veteran trees are of national importance, and any lost are considered irreplaceable. Given a small number of veteran trees would be lost, the overall integrity of the veteran tree resource within the ZoI would be maintained, and the diversity of species and levels of species populations which ancient and veteran trees support within the ZoI, would likely be sustained following their removal. Therefore, an irreversible permanent minor adverse level of impact would occur, resulting in a moderate adverse effect that is **significant**.

Woodland and scrub

8.6.55 Construction works would result in the permanent removal of 7.03ha of semi-natural broadleaved woodland, 34.86ha of plantation woodland and 4.39ha of scrub habitats that are of county importance. To compensate for the loss of non-ancient woodland and scrub, 104.23ha of new woodland and 11.23ha of scrub planting is proposed as part of the landscaping plans (see Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.15, LSP.19, S1.08, S1.14 and S2.01). However, it would be expected that newly planted semi-natural woodland would take in excess of 30 years to become sufficiently established and mature to compensate for the predicted losses, although scrub habitat would be sufficiently established within approximately one to seven years. Overall, an irreversible permanent minor adverse level of impact on the

county-level important woodland resource would persist for the short and medium-term (up to 30 years). This would result in effects that would be slight adverse and **not significant**. This effect would eventually become slight beneficial in the long term, with the establishment of the new woodland planting.

Scattered and parkland trees

8.6.56 The parkland trees within Cobham Hall School are outside the Order Limits and so will not be directly impacted by the Project resulting in no change to this habitat type. As such, the effects on the national-level important resource would be neutral and **not significant**.

Grassland

8.6.57 The Project would result in the loss of 20.07ha of semi-improved neutral grassland and 2.73ha of calcareous grassland of county importance. Additional losses of 60.77ha of species-poor semi-improved grassland and 20.62ha of improved grassland of local importance would also occur. To compensate for this impact, 120.62ha of species-rich grassland, and 30.78ha of species-rich chalk grassland will be created within habitat creation areas and the landscape planting, which would be expected to take approximately 15 years to become sufficiently established to compensate for the predicted losses (see Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.18, LSP.20 and LSP.22). An additional 18.85ha of species-poor semi-improved grassland and 3.24ha of improved grassland would also be reinstated. Following creation and reinstatement of the grassland habitats, a temporary negligible adverse level of impact would occur and the overall effects would be slight adverse and **not significant**.

Standing water

8.6.58 Construction works would result in the irreversible permanent loss of six ponds, within one of which GCN presence has been confirmed. As described in Section 8.5, the loss of any non-GCN ponds will be compensated through the creation of new ponds at a ratio of 1:1 within mitigation areas and as part of landscape planting (Figure 2.4: Environmental Masterplan (Application Document 6.2)). The pond for which GCN presence has been confirmed will be compensated with the creation of two new ponds, as detailed in the amphibians section below (see paragraphs 8.6.92 to 8.6.97). Construction works would also result in the reversible temporary loss of a small section of the canal adjacent to Filborough Marshes. This will be reinstated following construction. With the implementation of these measures, this is considered to be a small-scale permanent minor adverse level of impact on standing water of county importance and would result in effects that are considered to be slight adverse and **not significant**.

Hedgerows

8.6.59 The Project would result in the irreversible permanent loss of 4.84km of hedgerow habitat. As outlined in Section 8.5, good practice guidance set out in the CoCP (Application Document 6.3, ES Appendix 2.2) and commitments in the Design Principles (Application Document 7.5) Clause no. LSP.13, would be followed to compensate for this loss by planting new native hedgerow and improving existing hedgerows. It is expected that newly created hedgerow habitat would take approximately five to ten years to become sufficiently

established and mature to compensate the predicted losses. With the implementation of these measures, this is considered to be a permanent minor adverse level of impact on hedgerow habitat of county importance and would result in effects that are considered to be slight adverse and **not significant**.

Open mosaic habitat

8.6.60 The open mosaic habitat of national importance within the area around Singlewell substation is located within the Order Limits. The construction of the Project would result in the irreversible permanent loss of 4.43ha of this habitat. To compensate for this, 13.86ha of open mosaic habitat creation is proposed on a site of existing improved grassland to the north-west of Shorne Woods (see Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.22). This newly created habitat will be subject to management and maintenance after construction to ensure it remains as open mosaic habitat and does not mature into successional scrub and woodland. Following the creation of this compensatory habitat, the coherence and integrity of the open mosaic habitat resource within the ZoI would be sustained and the level of impact would be temporary negligible adverse, resulting in effects that would be slight adverse and **not significant**.

Coastal and floodplain grazing marsh

8.6.61 An area of coastal and floodplain grazing marsh of national importance within Filborough Marshes and Canal and Grazing Marsh Higham LWS is located within the Order Limits. Most of the habitat will be retained as this habitat is largely located above the proposed tunnel. However, the construction of a temporary construction compound would result in the reversible temporary loss of 0.36ha of habitat. To compensate for this, 2.12ha of permanent coastal and floodplain grazing marsh will be created. Following the reinstatement and creation of the habitats, the coherence and integrity of the open mosaic habitat resource within the ZoI would be sustained and the level of impact would be temporary negligible adverse, resulting in effects that would be slight adverse and **not significant**.

Coastal habitats

8.6.62 For an assessment on the impacts on the coastal habitat, please refer to Section 9.6 of Chapter 9: Marine Biodiversity.

Other habitats

8.6.63 Predicted reversible losses of other semi-natural habitats, including swamp and marginal vegetation (0.35ha) and running water (a minor stream) (0.15km) of county importance would be temporary in nature and required to facilitate construction works. These habitats would be reinstated following construction works so that no net loss in their extent would occur. The temporary losses would be further compensated by the wider proposals of habitat creation (see Section 8.5 and Figure 2.4: Environmental Masterplan (Application Document 6.2)).

8.6.64 Similarly, the losses of arable land (305.73ha) of local importance would be partly compensated by the reinstatement of 110.65ha following construction. The residual irreversible permanent loss of ecologically low value arable land

would be compensated by the wider proposals for habitat creation, where a net gain of approximately 220.7ha of ecologically higher value semi-natural habitats of county importance or greater (Table 8.31 would be provided in the landscape planting and the areas to the north, east and west of Shorne Woods. Over time, this would contribute to enhancing the natural environment locally, by establishing coherent ecological networks that are more resilient to current and future pressures. Excluding consideration of the irreplaceable losses of ancient woodland and veteran trees, the proposed habitat creation would result in an overall permanent major beneficial level of impact to biodiversity that would result in a slight beneficial effect that is **not significant**.

8.6.65 **Habitat degradation**: Reversible temporary indirect impacts associated with dust deposition during the construction phase in dry spells could result in the degradation of retained habitats of county importance. As summarised in Section 8.5, this would be avoided by the dust suppression methods set out in the CoCP (Application Document 6.3, ES Appendix 2.2). No significant short-term or long-term impacts are anticipated, resulting in a temporary negligible adverse level of impact. The effects on habitats would therefore be neutral and **not significant**.

8.6.66 Construction works could also result in hydrological drawdown of other water bodies or wetter habitats of county importance such as marshy grassland and swamp areas, specifically around the South Portal. Mitigation measures set out in Chapter 14: Road Drainage and the Water Environment will compensate for the adverse effects associated with this. With the inclusion of these measures, the level of impacts is considered to be reversible temporary negligible adverse and therefore, the drawdown effects on habitats would be slight adverse and **not significant**.

8.6.67 Construction works within close proximity to ponds and other water bodies of county importance could result in degradation through surface water runoff. As summarised in Section 8.5, mitigation measures to control runoff and the discharge of pollutants into water bodies are set out in the CoCP (Application Document 6.3, ES Appendix 2.2). The inclusion of these measures would result in a reversible temporary negligible adverse level of impact and effects that are considered to be slight adverse and **not significant**.

Protected and notable plant species

8.6.68 The Project could result in the loss of protected or otherwise notable plant species. However, construction works are proposed away from sites where these species have been found. Project design and mitigation measures outlined in Section 8.5 would safeguard such species from likely indirect effects during construction. As such, no observable impact is currently envisaged and therefore, the effects of the Project would be neutral and **not significant**.

Terrestrial invertebrates

8.6.69 The likely effects associated with the construction phase on terrestrial invertebrates would be:

a. Habitat loss

b. Mortality

c. Disturbance

d. Habitat fragmentation

e. Habitat degradation

8.6.70 **Habitat loss and direct mortality:** Land-take in Survey Areas 1 and 2 (see Figure 8.7 (Application Document 6.2)) as a result of the Project would result in loss of foraging, breeding and resting habitat for terrestrial invertebrates, and incidental mortality associated with the habitats being lost through vegetation and ground clearance works. As these two impact pathways are closely associated, they are assessed together. Area 12 would not be directly affected by the Project.

8.6.71 Habitat loss pertains primarily to ancient woodland in both Areas 1 and 2 and open mosaic/grassland habitat in Area 2. In Area 1, approximately 2.9% of the Shorne and Ashenbank Woods SSSI would be permanently lost, with the potential to impact on 13 species of invertebrates of notable conservation status and one Specific Assemblage Type (SAT) ('rich flower resource') of high conservation value. In Survey Area 2, 29 species of notable conservation status and three SATs ('scrub edge', 'open short sward' and 'rich flower resource') would be partly lost. This equates to 48% of Claylane Wood ancient woodland and grassland. These losses would be irreversible.

8.6.72 For both survey areas, the habitat lost as part of the vegetation clearance would be compensated for over time by new woodland planting expanding Shorne Woods to the east (see Section 8.5) and grassland creation to the north-west of Shorne Woods. The salvage of topsoil, coppice stools and dead wood from under the footprint of the Project to the new woodland planting areas would reduce the time taken for the newly created habitat to establish, and help sustain the conservation status of the invertebrate assemblage. This woodland creation would likely take over 30 years to become fully established, although it would be suitable for use by invertebrates prior to maturation. However, given the ancient nature of some of the lost habitat with which the notable invertebrates are associated, and the length of time newly created habitats would take to mature in relation to the short life-cycles of invertebrates, it is considered that the impact would be permanent minor adverse that would result in a slight adverse effect that is **not significant** for Areas 1 and 2.

8.6.73 A construction compound would be required south of the Metropolitan Police firing range, which falls within Area 12. This compound totals 6% of Area 12, and the habitat loss would be temporary and reversible during the construction phase, although it would result in the loss of foraging, breeding and resting habitat for terrestrial invertebrates, and incidental mortality. Following the completion of the Project, the habitat in this area will be reinstated to include slow-flowing ditches, ponds, grassland and scrub habitat, which would enhance this area for terrestrial invertebrates. There would be a permanent minor adverse level of impact that would result in a slight adverse effect that is **not significant**. In the longer term, the permanent habitat enhancements would lead to a minor beneficial impact that would result in a slight beneficial effect that is **not significant**.

8.6.74 Table 8.31 outlines the predicted habitat losses and gains associated with Areas 1 (Shorne, Ashenbank and Brewers Woods) and Area 2 (Claylane Wood).

8.6.75 **Disturbance**: Nocturnal species attracted to light (in particular, moths but also other invertebrate species) could suffer temporary disturbance during the construction phase, from artificial lighting used to illuminate construction areas in close proximity to retained habitats. Some compounds will have 24-hour lighting, particularly around the South Portal construction area. This could increase the exposure of invertebrates to predation and reduce the abundance and diversity of the invertebrate assemblages. The lighting design for these compounds has been designed so that the light spill from these compounds would fall to 0.5 lux at a distance of 30m from the compound location (please refer to Appendix 8.15: Construction and Operational Light Spill Calculations (Application Document 6.3).

8.6.76 The implementation of the construction phase lighting design would reduce the severity of the impact such that it would be a reversible temporary negligible adverse level of impact that would not affect the conservation status of the invertebrate assemblages within these areas of national and regional importance. Therefore, the effect would be slight adverse and **not significant**.

8.6.77 **Habitat fragmentation**: Proposed woodland planting linking Claylane Wood to Shorne Woods Country Park (via the proposed Thong Lane green bridge north), and the proposed Thong Lane green bridge south linking Shorne Woods (north of the A2) to Ashenbank Wood (south of the A2), have the potential to reduce existing habitat fragmentation between Survey Areas 1 and 2, and within Survey Area 1, which are of national and regional importance to terrestrial invertebrates.

8.6.78 The proposed planting would compensate for any irreversible adverse effects associated with fragmentation caused from hedgerow and other habitat removal. It has been designed to provide a more connected landscape, which would allow invertebrates to increase their abundance and distribution within the local area. It would represent an improvement over the baseline conditions and provide an overall permanent minor beneficial level of impact to terrestrial invertebrates that would result in a slight beneficial effect that is **not significant**.

8.6.79 **Habitat degradation**: Habitat degradation due to possible pollution events, dust deposition and accidental drainage of land has the potential to have a reversible adverse impact on invertebrates within retained habitats. However, the inclusion of the good practice mitigation measures outlined in Section 8.5 to prevent pollution incidents and control surface water runoff would reduce the risk of such incidents and result in no change and an effect that is neutral and **not significant**.

Freshwater species

Macro-invertebrates

8.6.80 The likely effects associated with the construction phase on freshwater macro-invertebrates are considered to be:

a. Habitat loss
b. Direct mortality
c. Habitat disturbance
d. Water quality deterioration
e. Habitat degradation

8.6.81 **Habitat loss and direct mortality**: During the construction phase, one watercourse located immediately south of the Metropolitan Police firing range would be diverted (Appendix 14.4: Hydromorphology Assessment (Application Document 6.3)), which would cause direct mortality and the loss of 50m of habitat containing county-level important macro-invertebrates that inhabit it. In addition, 50m of the northern bank of the Thames and Medway Canal would also be impacted by the establishment of a shaft for the ground protection tunnel. The watercourse diversion would create an additional 50m of suitable habitat (refer to Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. S9.13 and LSP.22). After the construction period, this watercourse would be reinstated to provide macro-invertebrate habitat. In addition, the site of the construction compound would be reinstated to create additional slow-flowing ditch and pond habitat which would be suitable for macro-invertebrates. The inclusion of this embedded mitigation would enable the conservation status and overall diversity of the invertebrate populations here to be sustained, resulting in a temporary negligible adverse level of impact. The resultant effects would be slight adverse and **not significant**.

8.6.82 **Habitat disturbance, habitat degradation and deterioration in water quality**: The tunnels associated with the Project would extend beneath the Thames Estuary and Marshes Ramsar site and South Thames Estuary and Marshes SSSI at Filborough Marshes. Construction of the main tunnels and the ground protection tunnel has the potential to lead to reduced water levels within the ditch system associated with the designated site. This could result in effects on the macro-invertebrate communities that inhabit the ditches through habitat degradation/loss. However, groundwater level data from boreholes within the Ramsar indicates that there is insufficient hydraulic head difference to drive net flow from the study area to the lower strata (see Appendix 14.5 (Application Document 6.3)). The lack of connection between the groundwater and the surface water would mean that there will be no impact on the water levels within the watercourse south of the River Thames. The rainwater runoff from the South Portal has been designed to flow into the Thames Estuary and Marshes Ramsar site and South Thames Estuary and Marshes SSSI following pollution prevention controls. The flow will be regulated to ensure the discharge flow rates are managed at greenfield runoff rates.

8.6.83 The mobilisation of ground contaminants resulting in leaching into the local watercourses and increased sedimentation of watercourses caused by large excavations either near or within watercourses has the potential to affect macro-invertebrate communities through a deterioration of water quality, resulting in mortality of the macro-invertebrate communities. The build-up of sediment has the potential to increase deposition of habitat colonised by macro-invertebrates. As summarised in Section 8.5, mitigation measures to control runoff and the discharge of pollutants into watercourses are set out in the CoCP (Application Document 6.3, ES Appendix 2.2) and the REAC (REAC Ref. RDWE033). These measures would reduce the risk of pollutants entering watercourses that provide habitat for county-level important macro-invertebrates. The Project would result in no change to the biodiversity resource and likely effects on macro-invertebrates in this area would therefore be neutral and **not significant**.

8.6.84 Temporary reversible impacts associated with dust deposition during the construction phase have the potential to result in indirect habitat degradation through dust settling in watercourses, smothering habitat and resulting in deterioration of water quality caused by contaminants in the dust. This would be avoided by the dust suppression controls set out in the CoCP (Application Document 6.3, ES Appendix 2.2), as summarised in Section 8.5. This would avoid impacts and therefore the effects on macro-invertebrates would be neutral and **not significant**.

Macrophytes

8.6.85 The likely effects associated with the construction phase on aquatic macrophytes would be:

a. Habitat loss

b. Water quality deterioration

c. Habitat degradation

8.6.86 **Habitat loss**: During the construction phase, one watercourse located immediately south of the Metropolitan Police firing range would have to be diverted (Appendix 14.4: Hydromorphology Assessment (Application Document 6.3)). The diversion of this watercourse would cause 50m of habitat loss. In addition, 50m of the northern bank of the Thames and Medway Canal would also be impacted by the establishment of a shaft for the ground protection tunnel. The watercourse would be diverted creating an additional 50m of watercourse habitat suitable for macrophytes (refer to Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2). After the construction period, the existing watercourse would be reinstated to provide macrophyte habitat. In addition, the site of the construction compound would be reinstated to create additional slow-flowing ditch and pond habitat which would support macrophytes. The inclusion of this embedded mitigation would enable the conservation status and overall diversity of the macrophyte communities here to be sustained, resulting in a temporary negligible adverse level of impacts. The resultant effects would be slight adverse and **not significant**.

8.6.87 **Habitat degradation and deterioration in water quality**: The tunnels associated with the Project would extend beneath the Thames Estuary and Marshes Ramsar site and South Thames Estuary and Marshes SSSI at Filborough Marshes. Construction of the main tunnels and the ground protection tunnel has the potential to lead to reduced water levels within the ditch system associated with the designated site. This could result in effects on the macrophyte communities present in the ditches through habitat degradation/loss. However, groundwater level data from boreholes within the Ramsar indicates that there is insufficient hydraulic head difference to drive net flow from the study area to the lower strata (see Appendix 14.5 (Application Document 6.3)). The lack of connection between the groundwater and the surface water would mean that there will be no impact on the water levels within the watercourse south of the River Thames. The rainwater runoff from the South Portal has been designed to flow into the Thames Estuary and Marshes Ramsar site and South Thames Estuary and Marshes SSSI following pollution

prevention controls. The flow will be regulated to ensure the discharge flow rates are managed at greenfield runoff rates.

8.6.88 The mobilisation of ground contaminants resulting in leaching into the local watercourses and increased sedimentation of watercourses caused by large excavations either near or within watercourses has the potential to affect macrophyte communities through a deterioration of water quality. As summarised in Section 8.5, mitigation measures to control runoff and the discharge of pollutants into watercourses are set out in the CoCP (Application Document 6.3, ES Appendix 2.2) and the REAC (REAC Ref. RDWE033). These measures would reduce the risk of pollutants entering watercourses that provide habitat for county-level important macrophytes. The Project would result in no change to the biodiversity resource and likely effects on macrophytes in this area would therefore be neutral and **not significant**.

8.6.89 Temporary reversible impacts associated with dust deposition during the construction phase have the potential to result in indirect habitat degradation through dust settling in watercourses, smothering habitat and resulting in deterioration of water quality caused by contaminants in the dust. This would be avoided by the dust suppression controls set out in the CoCP (Application Document 6.3, ES Appendix 2.2), as summarised in Section 8.5. This would avoid impacts and therefore the effects on macrophytes would be neutral and **not significant**.

Amphibians

8.6.90 The populations of GCN recorded within the study area to the south of the River Thames were assessed as being of county importance for biodiversity. The assemblages of other species of amphibians within the ZoI were assessed as being of local or lower importance and as such have not been assessed further. Despite this, works would be undertaken in accordance with good practice to safeguard these species, as outlined in Section 8.5.

8.6.91 The likely effects associated with the construction phase on GCN would be:

a. Habitat loss

b. Direct mortality

c. Habitat fragmentation

d. Habitat degradation

8.6.92 **Habitat loss:** The areas of habitat loss for each GCN population are shown on Figure 8.8 (Application Document 6.2) and in Table 8.32 below. As per instruction from Natural England, permanent irreversible habitat loss constitutes loss under the Project; habitats where the new A122 Lower Thames Crossing would create a barrier making the habitats no longer available to GCN post-construction; and any habitat change through landscaping. Temporary reversible loss constitutes any habitat lost and reinstated as the same habitat. Further details are provided in Appendix 8.17: Draft EPS mitigation licence application – great crested newts (Application Document 6.3).

Table 8.32 Loss of terrestrial habitat within 500m of breeding ponds for each population to the south of the River Thames

Population	Habitat loss (ha) within 50m of pond*	Habitat loss (ha) within 50m–250m of pond	Habitat loss (ha) within 250m–500m of pond	Suitability of habitats affected
S1	0ha	1.94ha	4.39ha	Woodland, scrub, semi-improved grassland, tall ruderal and fern and amenity grassland
S2	1.16ha	9.26ha	22.99ha	Majority of loss is within improved grassland and arable land that is suboptimal for GCN. However, some losses would also occur within semi-improved grassland, woodland, and scrub.
S3	0ha	0ha	3.37ha	Loss entirely within arable habitat considered suboptimal for GCN
S4	0ha	0.14ha	2.58ha	Tall herb and fern and wetland habitat suitable for GCN
Total	**1.16ha**	**11.34ha**	**33.33ha**	

8.6.93 Construction works within the vicinity of ponds associated with GCN Population S1 comprise a new junction between the A2 and HS1 railway, and the provision of a new cycle path within Ashenbank Wood along an existing path. The Project would not result in the loss of any water bodies known to support breeding GCN. The Project would result in habitat loss of 0.14ha of semi-natural habitat within 250m of P003N and P004N, considered to be of high value to GCN. Given the large extent of the valuable woodland habitat adjacent to these ponds, this is considered to be a small amount of the available habitat.

8.6.94 Population S2 comprised 11 known GCN ponds within Shorne Woods. Pond P249S is located within the Order Limits and would be permanently lost during essential utility works due to the proposed widening of the A2. This is a single pond at the periphery of the source population. This will also result in the loss of terrestrial habitat (woodland) in the vicinity. However, this is considered to be a small amount given the large extent of the valuable woodland habitat adjacent to these ponds.

8.6.95 A construction compound is proposed 315m south-west of the breeding ponds associated with Population S3. This would result in a temporary loss of 3.37ha within arable fields considered of little value to GCN. It is not likely that the construction of this compound would result in the severance of GCN habitat that could limit the dispersal of GCN between terrestrial and breeding habitat due to the distance from the ponds, and the presence of only low value arable farmland habitat.

8.6.96 The provision of a ground protection tunnel compound is proposed within 250m of Population S4 with the closest pond located approximately 245m from any vegetation clearance. This would result in a small temporary loss of semi-improved grassland and tall ruderal with the majority outside the core habitat (>250m) for this population.

8.6.97 A large herpetofauna mitigation area is proposed to the west of Shorne Woods, comprising 13ha rough mosaic grassland creation with the provision of two new ponds to compensate in advance of the loss of breeding and terrestrial habitat associated with Population S2 (refer to Section 8.5 and Figure 2.4: Environmental Masterplan (Application Document 6.2)). The habitat loss close to S1, S3 and S4 are considered either small-scale and/or temporary, particularly in relation to the large amount of high value habitat within 500m of each metapopulation. The inclusion of the mitigation measures outlined would sufficiently compensate the adverse effects associated with habitat loss on the GCN populations of county importance such that the conservation status of the population would be maintained. Therefore, a temporary negligible adverse level of impact would occur, resulting in effects that are considered to be slight adverse and **not significant**.

8.6.98 **Direct mortality**: GCN may be encountered within suitable breeding and terrestrial habitats within 500m of a known GCN breeding pond. As such, works within these areas have the potential to injure and/or kill GCN. The successful implementation, under an appropriate European Protected Species mitigation licence with respect to GCN (Appendix 8.17 (Application Document 6.3)), of the embedded mitigation measures described in Section 8.5 (species translocation, phased vegetation clearance, installing exclusion fencing, site supervision and habitat restoration) would safeguard GCN and prevent the incidental injury or mortality of animals. This would result no change to the county-level important GCN population as a whole and therefore, the effect on GCN would be neutral and **not significant**.

8.6.99 **Habitat fragmentation**: Construction works close to known GCN populations S1 and S2 are mainly adjacent to the existing A2/M2, which is already considered to be a significant existing barrier to GCN movements and as such the impact is considered negligible. Utility works to divert a gas pipe adjacent to Halfpence Lane in the vicinity of Population S1 would cause a temporary reversible fragmentation between the ponds within this metapopulation. Works close to populations S3 and S4 would be small-scale and temporary and are considered to be sufficiently far from the GCN populations to avoid fragmenting their habitats and severing the connections to other GCN populations. As such, the level of impact is considered to be temporary negligible adverse. The overall effects of fragmentation are considered to be slight adverse and **not significant**.

8.6.100 **Habitat degradation**: Construction works within close proximity to ponds could result in degradation through surface water runoff. As summarised in Section 8.5, mitigation measures to control runoff and the discharge of pollutants into water bodies are set out in the CoCP (Application Document 6.3, ES Appendix 2.2). This would result in a reversible temporary negligible adverse level of impact on populations of county importance and effects that are considered to be slight adverse and **not significant**.

Reptiles

8.6.101 The likely effects associated with the construction phase on reptiles would be:

a. Habitat loss

b. Direct mortality

c. Habitat fragmentation

8.6.102 **Habitat loss**: The most suitable areas for reptiles to the south of the River Thames were located north of the South Portal. Construction of the Project would result in the loss of 33.84ha of potentially suitable reptile habitat. South of the firing range, a temporary compound for construction will result in the loss of 4.17ha of habitat, with over 25ha of the firing range being retained. Following the completion of the Project, this area will be reinstated with slow-flowing ditches, ponds, grassland and scrub which will be suitable for reptiles. The habitat to the south of the South Portal was more limited to discrete areas which each supported low populations of one or two species, with the exception of one area which had a good population of common lizard. The Project would result in the loss of habitat considered suitable to support these reptiles, including arable field margins, grassland (particularly adjacent to the A2), open mosaic habitat (especially Southern Valley Golf Course and Singlewell substation) and woodland edge habitat (near Claylane and Shorne Woods). The amount of habitat lost is outlined in Table 8.31 .

8.6.103 The habitat lost as part of the vegetation clearance would be compensated by the creation of diverse habitat as part of the Project, as outlined in Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.15, LSP.19, LSP.22, S1.08, S1.14, and S2.01. This would include an area of open mosaic habitat adjacent to Shorne Woods and extensive areas of woodland planting. The mitigation area would include features suitable for reptiles including varied topography providing slopes and banks for basking, log and brash piles, and areas of scrub and flower-rich grassland, providing foraging and hibernation sites. As the planting matures, the newly created landscape planting would also provide considerable areas of additional habitat for reptiles (see Section 8.5).

8.6.104 The inclusion of the mitigation measures as detailed above would compensate for the predicted habitat losses such that the level of impact on the reptile populations, which are of county importance, would be reversible temporary negligible adverse and result in effects that are considered to be slight adverse and **not significant**.

8.6.105 **Direct mortality**: Mainly low populations of common and widespread species of reptile were recorded across the study area to the south of the River Thames. In the absence of mitigation, activities such as vegetation clearance, stockpiling of equipment and material have the potential to harm or kill reptiles. When disturbed, reptiles frequently bury themselves beneath vegetation to evade predation. The latter response to predation makes them particularly vulnerable to being crushed by heavy machinery.

8.6.106 Mitigation measures would include phased and directional habitat clearance, and translocation of reptiles to a receptor site that would be managed and

enhanced for reptiles in advance of translocation occurring (refer to the CoCP (Application Document 6.3, ES Appendix 2.2) and Figure 2.4: Environmental Masterplan (Application Document 6.2)).

8.6.107 The removal of reptiles from the construction footprint and the inclusion of additional mitigation to prevent reptiles re-entering the construction area where necessary, such as the installation of reptile-proof fencing (refer to the CoCP (Application Document 6.3, ES Appendix 2.2) and Figure 2.4: Environmental Masterplan (Application Document 6.2)) would result in temporary negligible adverse impacts on the reptile populations, which are of county importance, and result in effects that are considered to be neutral and **not significant**.

8.6.108 **Habitat fragmentation**: The Project may result in the fragmentation of habitat. This can be particularly detrimental in marginal areas where suitable habitat is often limited. Small populations are intrinsically at greater risk of localised extinction; further fragmentation is likely to exacerbate this.

8.6.109 The impact of the east-west fragmentation south of the River Thames would be compensated by the creation of the Thong Lane green bridge north as detailed in Section 8.5 and in Figure 2.4: Environmental Masterplan (Application Document 6.2)). This would include hedgerow and grassland planting and allow reptiles to move across the Project (Design Principles (Application Document 7.5) Clause no. PRO.04, PLA.05, STR.08, S2.04).

8.6.110 Two additional green bridges (Thong Lane green bridge south and Brewers Road green bridge) would also provide opportunities to link populations north and south of the A2/M2. Habitat fragmentation would be further compensated by the creation of new habitat along the Project which would provide new corridors for species, the benefits of which are likely to increase over time as they provide links between areas of retained habitat and the wider landscape.

8.6.111 The construction of the Project is anticipated to be unlikely to affect the status of reptile populations to the south of the River Thames through shading effects.

8.6.112 The creation of new grassland and routes for animals to disperse are likely to have a positive impact on populations of reptiles. Suitable habitat is often the limiting factor in arable landscapes. The creation of high-quality habitat is expected to connect existing reptile populations and provide opportunities for expansion. Reptiles are able to rapidly colonise new areas provided the habitat is suitable (Beebee and Griffiths, 2000).

8.6.113 The successful implementation of mitigation measures outlined in Section 8.5 and the Design Principles (Application Document 7.5) and shown on Figure 2.4: Environmental Masterplan (Application Document 6.2) would compensate the predicted adverse impacts of habitat fragmentation and result in overall permanent major benefits to reptiles from the opening year of the Project. The resultant effects on reptile populations of county importance would therefore be slight beneficial and **not significant**.

Ornithology

8.6.114 The likely effects on birds associated with the construction phase would be:

a. Habitat loss

b. Direct mortality

c. Disturbance

d. Habitat degradation

8.6.115 **Habitat loss:** All habitat types within the study area to the south of the River Thames have the potential to be used by nesting (both ground-nesting and otherwise), foraging and roosting birds. The full extent of habitat loss is presented in Table 8.31. The reversible temporary loss or irreversible permanent loss of any habitats would reduce the availability of potential nesting sites and foraging resources for birds throughout the duration of construction. In the short term, this would result in adverse effects, particularly for species that are associated with woodland habitats such as at Ashenbank Wood, Shorne/Brewers Woods and Claylane Wood.

8.6.116 Species nesting nearby, within the study area but beyond the Order Limits, may adapt their foraging behaviour and continue to breed as successfully as prior to commencement of construction. Others, such as skylark, may be displaced from breeding territories and may occur in reduced numbers because suitable retained habitat is already well used by breeding pairs.

8.6.117 During construction, retained margins and retained vegetation would provide some opportunities for foraging and nesting birds. The loss of mainly arable land and smaller areas of semi-natural habitat during construction would have a temporary adverse impact on breeding and non-breeding birds at site or local level. However, it is unlikely that such impacts would adversely affect the local conservation status of the bird assemblages.

8.6.118 Construction of the ground protection tunnel, and the associated compound, within the Metropolitan Police firing range will lead to the loss of a small area of rough grassland and wetland habitat, which is of particular value for foraging marsh harriers, particularly during the breeding season. The area of habitat loss is small (4.17ha) however when compared to the available habitat adjacent to the River Thames.

8.6.119 Implementation of the Project design and mitigation measures, including the creation of woodland, grassland, hedgerow and open mosaic habitats, as described in Section 8.5, the Design Principles (Application Document 7.5) and shown on Figure 2.4: Environmental Masterplan (Application Document 6.2), would compensate this adverse effect over time as newly created habitats establish and become suitable for use by woodland and farmland birds. The habitat creation proposals would provide a much more extensive and diverse mosaic of semi-natural habitats within the Order Limits, providing benefits of additional foraging and nesting opportunities compared to the largely agricultural habitats lost, with an overall gain predicted in the medium to long term for higher value habitats such as woodland and hedgerows. To further compensate for the loss of nesting opportunities while newly created habitats

establish, the habitat creation measures would be supplemented by the provision of bird nest boxes within areas of retained woodland and trees.

8.6.120 The overall level of impact from habitat loss would be temporary negligible adverse, not being of a sufficient extent or magnitude to be likely to affect the conservation status of the general bird assemblage to the south of the River Thames, which is of county-level importance. This would result in effects at the year of opening that are slight adverse and **not significant**.

8.6.121 **Direct mortality:** Nesting birds (the adult birds, nests, eggs and dependent young) are vulnerable to works occurring in close proximity that might damage or destroy a nest site during breeding (March to August inclusive). Implementation of the embedded and good practice mitigation measures (fencing, timing of vegetation removal and supervision of works) described in Section 8.5 and the REAC (Application Document 6.3, Appendix 2.2), REAC Ref. TB004) would lead to temporary negligible impacts and would provide protection for birds and their nests throughout the construction phase. The resultant effects would therefore be neutral and **not significant** on nesting birds south of the River Thames, which are of county-level importance.

8.6.122 Some low-flying bird species (e.g. thrushes and game birds) are especially vulnerable to collision with vehicles, particularly where site-traffic routes are near to features such as woodland edges and hedgerows. Implementation of the good practice mitigation measures described in Section 8.5 and detailed within the CoCP (Application Document 6.3, ES Appendix 2.2), including fencing of the construction area as well as the adherence to standard low speed limits of 10mph to 15mph for construction vehicles would reduce the risk of mortality of birds through collision. The level of impact would be temporary negligible adverse and would result in effects that are considered to be slight adverse and **not significant** on the general bird assemblage south of the River Thames, which is of county-level importance.

8.6.123 The Project includes the construction of alternative pylon routes to allow for the construction of the Project. One overhead line (OHL) alignment located to the north of the A2 is shifting 90m from the existing alignment. The location of this new alignment is over 2km from the River Thames, where the largest aggregation of birds are to be found. This, in addition to the presence of the existing OHL, would lead to a level of impact that is permanent minor adverse and would result in effects that are considered to be slight adverse and **not significant** on the general bird assemblage south of the River Thames, which is of county-level importance.

8.6.124 **Disturbance**: Nesting birds are also vulnerable to disturbance from changes in noise, lighting and vibration. Those bird species listed in Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) are afforded legal protection from disturbance while breeding. The embedded and good practice mitigation measures listed in Section 8.5, including the careful timing of vegetation removal to avoid nesting birds (see Appendix 2.2 (Application Document 6.3), REAC Ref. TB004), would avoid the risk of disturbance being caused to specially protected species that could be nesting within retained habitats. Furthermore, where potentially disturbing construction activities would commence during the bird breeding season in close proximity to retained habitats that could support specially protected nesting birds, the ECoW would first monitor those retained habitats and advise of any additional measures that

may be required to avoid disturbance, such as the use of screening or acoustic fencing, if the presence of specially protected species is confirmed.

8.6.125 It is considered that the location of the tunnel boring operations (main tunnels and ground protection tunnel) are sufficiently distant (in excess of 150m) from Shorne Marshes and other high-value habitats that could support particularly notable nesting species such as marsh harrier, and that the tunnelling activity will be at a sufficient depth, such that any noise and vibrations caused by the tunnel boring machines are not likely to result in any adverse effects on birds.

8.6.126 Similarly, most sources of increased noise levels arising from above-ground works would be in excess of 850m from Filborough Marshes and not likely to cause any significant disturbance to particularly notable birds such as marsh harrier. The nearest source of disturbance (activity at the compound of the reception shaft for the ground protection tunnel, 20m away from the northern edge of Filborough Marshes) is not likely to create significant disturbance for breeding birds within the habitats adjacent to the River Thames. This is further confirmed when considering the high levels and irregularity of background noise disturbance from the existing railway line and Metropolitan Police firing range, both of which are immediately adjacent to the main habitats suitable for breeding birds, and which form part of the baseline conditions in this area.

8.6.127 Overall, disturbance to nesting birds, which are county-level importance, would be a reversible temporary negligible adverse level of impact, resulting in effects that would be slight adverse and **not significant**, following the implementation of suitable mitigation measures.

8.6.128 Construction-related activities would result in an increase in noise levels that could cause disturbance to non-breeding birds in the surrounding area, potentially including non-breeding birds that are associated with the Thames Estuary and Marshes SPA and Ramsar site. The additional noise would likely be irregular in nature, however there is already a high level of irregular background noise from the existing railway line and Metropolitan Police firing range. In addition, most sources of increased noise levels arising from above-ground works would be in excess of 850m from the habitats located adjacent to the River Thames, with a small area of construction immediately adjacent to the northern edge of Filborough Marshes. The addition of this construction noise is therefore unlikely to cause significant disturbance. Visual disturbance would be likely to affect birds by causing them to avoid areas of habitat that might otherwise be used for foraging and resting. Implementation of the good practice measures described in Section 8.5, including the use of screening where necessary to safeguard any particularly sensitive areas such as the Thames Estuary and Marshes SPA and Ramsar site, would reduce the impact of disturbance. It is likely that disturbance of non-breeding birds would be a reversible temporary negligible adverse level of impact that would not affect the conservation status of the bird populations concerned. Therefore, the effect on the bird populations of county importance would be slight adverse and not significant. Further details regarding the assessment of birds associated with the Thames Estuary and Marshes SPA and Ramsar site are provided in Appendix 8.7 (Application Document 6.3).

8.6.129 **Habitat degradation**: The tunnels associated with the Project would extend beneath the Thames Estuary and Marshes Ramsar site and South Thames Estuary and Marshes SSSI at Filborough Marshes. Construction of the main tunnels and the ground protection tunnel has the potential to lead to reduced water levels within the ditch system associated with the designated site. This could result in effects on small mammals and other species that inhabit the ditches (through habitat degradation), which provide a significant prey resource for birds such as marsh harrier. However, groundwater level data from boreholes within the Ramsar site indicates that there is insufficient hydraulic head difference to drive net flow from the study area to the lower strata (see Appendix 14.5 (Application Document 6.3)). The lack of connection between the groundwater and the surface water would mean that there will be no impact on the water levels within the watercourse south of the river. The impact of dewatering on Filborough Marshes would therefore be no change and result in effects that are neutral and **not significant**.

Bats

8.6.130 The assemblage of bat species within the ZoI to the south of the River Thames has been assessed as being of county importance, as outlined in Section 8.4.

8.6.131 The likely effects of construction on bats would be:

a. Habitat loss

b. Disturbance

c. Habitat fragmentation

d. Direct mortality

8.6.132 **Habitat loss**: The construction of the Project would result in habitat loss of foraging and commuting habitat of limited value for bats, owing to the land within the Order Limits being lost predominantly consisting of arable (342.53ha), amenity grassland (37.31ha), species-poor semi-improved grassland (60.87ha), semi-improved neutral grassland (20.01ha) and improved grassland (20.60ha); this is considered suboptimal habitat. The grassland habitat onsite being of limited value to bats is confirmed by, amongst other data, bat activity data at Transect 7 automated static locations. Transect 7 automated static locations were situated within the largest block of arable/grassland to be impacted by works and recorded the lowest average level of bat passes south of the River Thames per night.

8.6.133 There are areas of greater importance to the local bat population which includes Ashenbank Wood, Shorne Woods, Gravelhill Wood, Claylane Wood as well as a mature hedgerow west of Shorne Woods and all three crossing point surveyed locations. Relatively moderate to high levels of bat activity were recorded in these areas as shown by the summarised data in the baseline conditions section. These areas would be impacted by differing amounts of vegetation removal within them (refer to Table 8.31) but would partly account for the 5.35ha of ancient woodland, 7.03ha of semi-natural broadleaved woodland, 34.86ha of plantation woodland and 4.39ha of scrub habitat to be lost south of the River Thames.

8.6.134 Habitat losses south of the River Thames in the short term would have a temporary moderate adverse impact on bats. The remaining habitat losses, comprising predominantly arable, amenity grassland, species-poor semi-improved grassland, semi improved neutral grassland and improved grassland would result in the irreversible loss of suboptimal foraging habitat. This classification as suboptimal foraging habitat is shown by low levels of bat activity at Transect 7 and Transect 8 and 9 automatic static locations, all of which are in the aforementioned habitats.

8.6.135 The replacement planting of semi-improved natural broadleaved woodland and plantation woodland habitat is predicted to be of at least equal value to what is going to be lost and likely higher quality compared to the plantation woodland, although would take at least 30 years to become sufficiently established. The irreversible lost ancient woodland is classed as irreplaceable habitat, although to help compensate the loss, 48.75ha of ancient woodland compensation planting would be provided. The habitat lost is likely to be of a high value to bats, however, there are large areas of ancient woodland habitat in the wider landscape which the local bat population would still be able to utilise. A total of 4.84km of hedgerow habitat would be lost but new hedgerow habitat would be created as well as improving existing hedgerows which would take approximately five to ten years to become sufficiently established.

8.6.136 Replacing lower quality grassland with grassland that has a greater species diversity would result in greater invertebrate numbers and diversity, resulting in better foraging for bats once habitats begin to establish (approximately five to ten years).

8.6.137 One tree roost (Tree 284 a soprano pipistrelle day roost (peak count 1), one probable brown long-eared bat day roost (peak count 1)) and one building roost would be lost (1 Longview, a common pipistrelle day roost (peak count 3)) as part of the construction of the Project. These roosts supported three widespread and common species and their removal of the roosts would be undertaken under a European Protected Species mitigation licence with respect to bats from Natural England (Appendix 8.16 (Application Document 6.3)). Compensation and mitigation measures would be implemented prior to their removal, including the installation of artificial bat roosts on retained trees suitable for these species and the creation of a new shelter structure for hibernating.

8.6.138 The habitat loss associated with woodlands and trees would result in the additional loss of 20 high suitability and 31 moderate suitability bat roost trees. The loss of these features would be compensated in advance of any loss, as outlined in Section 8.5 and the REAC (Appendix 2.2 (Application Document 6.3), REAC Ref. TB009) through the provision of artificial bat roosts within retained areas of woodlands and trees. This is in addition to the habitat creation which would have a minor medium to long term beneficial impact on bats.

8.6.139 Overall, impacts of habitat loss on the bat assemblage, which is of county importance, would be compensated by the proposed mitigation and compensation measures such that the level of impact in the short to medium term would be permanent minor adverse, resulting in effects that would be slight adverse and **not significant.**

8.6.140 **Disturbance:** Activities resulting in increased levels of noise, vibration or light can lead to bats abandoning roosts as well as severing flightlines and abandoning foraging habitat as they seek to avoid the disturbance. Although some bat species can become habituated to a degree of disturbance, this is less likely to happen if the disturbance begins when bats are already present. Bats are particularly susceptible to disturbance impacts during the sensitive hibernation and maternity periods.

8.6.141 Five of the roosts identified within man-made structures and a confirmed tree roost (Tree 911, a noctule day roost or local value) would be retained but potentially exposed to increased levels of disturbance through construction. Marling Manor (11m from construction works) and St Mary's Church (147m from construction works) were both known to support brown long-eared bat day roosts. The two Shorne Woods Air Raid Shelters (Bunker 1, and Bunker 2, 37m and 1m respectively away from construction works), are known to support a brown long-eared, Daubenton's and Natterer's bat hibernation roost. The small common pipistrelle hibernation roost/transitionary roost within the lime kiln tunnels at Muggins Chalk Pit (124m away from construction works) will also be retained. These bat roosts are considered to be of county importance.

8.6.142 Mitigation measures detailed in Section 8.5 and Section 12.5 of Chapter 12: Noise and Vibration, including the management of noise during construction to minimise the impacts on retained bat roosts. Section 8.5 also includes measures to reduce and/or avoid light spill on any important bat foraging and commuting locations please refer to Appendix 8.15: Construction and Operational Light Spill Calculations (Application Document 6.3).

8.6.143 It is likely that bats utilising the roosts at Marling Manor, Shorne Woods Air Raid Shelters and St Mary's Church are habituated to high levels of noise and light due to their close proximity to major roads (Marling Manor and Shorne Woods Air Raid Shelters are adjacent to the A2/M2, and St Mary's Church is adjacent to Rochester Road (A226)). Noise modelling of these roosts has shown that there will be a negligible or minor increase in noise levels at these roosts due to construction. Prior to construction, a new shelter structure would be constructed to mitigate for the temporary loss of the air raid bunkers to roosting bats, and bat boxes would be installed in retained woodland to mitigate disturbance to Marling Manor.

8.6.144 Muggins Chalk Pit would be 124m from habitat creation works, and over 300m from main construction activities. Due to the nature of the construction works, only a limited amount of disturbance is anticipated because of the short-term and low-impact nature of the works proposed to enhance the biodiversity of that area.

8.6.145 Tree 911 is 73m from construction works and is on the southern side of a woodland with HS1 railway 35m north in between the roost and construction works and a large house 15m west with no trees between it and the roost. The woodland is therefore anticipated to act as a partial barrier to disturbance and with the existing disturbance from HS1 and the house it is likely that bats using the roost are already habituated to noise and light. Noise modelling has shown that there will be a negligible increase in the noise levels during the construction phase.

8.6.146 With the mitigation measures detailed above, the level of impact from possible disturbance on the bat assemblage, which is of county importance, would be reversible temporary negligible adverse and result in effects that are slight adverse and **not significant**.

8.6.147 **Habitat fragmentation**: The construction of the Project would result in the severing of bat territories at three locations (as captured by the crossing point surveys), thus reducing the foraging habitat available to individual bats.

8.6.148 The commuting and foraging route identified to the north of the A2/M2 (Crossing Point 0.5; refer to Appendix 8.8 (Application Document 6.3) and Figure 8.25 (Application Document 6.2)) was used by foraging and commuting bats (particularly pipistrelle species) between Shorne and Claylane Woods. This crossing point would be permanently lost during construction of the new M2/A2/A122 Lower Thames Crossing junction.

8.6.149 The commuting and foraging route along the A226 (surveyed by Crossing Point 2 surveys) would be impacted on a small-scale by vegetation removal along the southern hedgerow to allow access into the southern tunnel entrance compound. The northern hedgerow along the A226 would not be impacted by the Project and this is where pipistrelle activity was highest (in general, pipistrelle activity was low to moderate). Activity levels in big bat and woodland bat species groups were relatively low/moderate and low respectively suggesting that it is unlikely to be a significant route used by these species. The crossing point data suggests this area is not as important to the local bat population, particularly south of the A226.

8.6.150 The crossing point at Thong Lane (Crossing Point 1 surveys) was used by pipistrelle and big bats with relatively low/moderate activity, particularly around dusk and dawn suggesting that bats may be using these hedgerows to commute. East of Thong Lane there are other connected hedgerows which can also be used to commute, reducing the dependence of bats to this particular hedgerow at Thong Lane. As one of the green bridges is being built at Thong Lane, any habitat fragmentation impacts will be temporary. Additionally, the species using this crossing point (big bats in particular) are not as reliant on linear features for commuting; for example noctules often fly at heights of 10 to 50m reducing the impact from this small loss of hedgerow.

8.6.151 To mitigate the impacts of fragmentation, three mixed-use green bridges would be created which would act to maintain bat commuting routes. These green bridges are designed to allow bats to cross over the Project and the A2/M2 and links a number of key woodland areas in the vicinity of the Project. The green bridges over the A2/M2 would replace existing road bridges and would enhance the existing connectivity in the wider environment. With the irreversible permanent loss of one crossing point, and the short term impact from the delay of the establishment of the green bridges, the habitat fragmentation impact on the bat assemblage, which is of county importance, would therefore be permanent minor adverse, and result in effects that are slight adverse and **not significant**.

8.6.152 **Direct mortality**: There are 20 high suitability and 31 moderate suitability bat roosting trees within the Order Limits to be lost as a result of the works. Although they were not identified to be supporting roosting bats (refer to Appendix 8.8 (Application Document 6.3)), the suitability for roosting bats remains during the construction phase. As detailed in Section 8.5, Appendix 8.16: Draft EPS mitigation licence application – bats (Application Document 6.3) and the REAC (Application Document 6.3, Appendix 2.2), REAC Ref. TB015) pre-construction surveys and inspections immediately prior to any felling works are proposed to mitigate the risk of killing or injuring bats.

8.6.153 Bat mortality due to direct contact with site vehicles is unlikely due to the low speed of site vehicles and the limited amount of 24-hour construction activities. As such, mortality of bats would be avoided and the likely impact on the county-level important bat assemblage within the ZoI to the south of the River Thames would be no change, and would result in effects that are neutral and **not significant**.

Dormice

8.6.154 The likely effects of construction on dormice would be:

a. Habitat loss

b. Direct mortality

c. Disturbance

d. Habitat fragmentation

8.6.155 **Habitat loss:** The most suitable areas for dormouse south of the River Thames are the wooded areas north and south of the A2. The Project would result in the loss of habitat considered suitable to support these animals: woodlands, dense scrub and hedgerows. The amount of dormouse habitat lost is anticipated to be 50.61ha, which comprises 15.75ha of optimal habitat (semi-natural deciduous woodland and scrub) and 34.86ha of suboptimal habitat (plantation woodland). An additional 4.84km km of linear habitat (hedgerows) that is suitable for use by dormouse would also be lost within the Order Limits.

8.6.156 The new junction and widening at the A2 would result in the irreversible loss of 5.85ha of woodland at Shorne and Ashenbank Woods SSSI. This is approximately 2.9% of Shorne and Ashenbank Woods SSSI, which is designated for its ancient woodland, although dormouse are not listed as a reason for notification of the SSSI. The Project alignment is proposed to join the A2 at the south-east corner of Claylane Wood. This will result in 4.24ha of permanent habitat loss. The area of Gravelhill Wood, which is adjacent to Shorne Woods but not part of any site designations, is anticipated to be lost completely due to temporary land-take for a compound to be constructed west of Thong Lane. This will result in 2.54ha of permanent habitat loss. A compound is proposed in the area that is currently Southern Valley Golf Course. The removal of these hedgerows would result in 6.25ha of scrub and plantation woodland loss and 0.66km of hedgerow habitat loss.

8.6.157 Dormouse are particularly sensitive to habitat loss due to their specialised feeding requirements and isolated woodlands are likely to lose their dormouse populations over time (Juskaitis, 2008).

8.6.158 The majority of areas requiring dormouse habitat removal would use persuasive movement through habitat clearance. Strips of suitable habitat will be progressively cleared under ecological supervision during the summer/early autumn to displace dormice away from construction areas and into adjacent retained areas of suitable dormouse habitat (see CoCP (Application Document 6.3, ES Appendix 2.2) REAC Ref. TB013). However, some areas would require capture and soft release into suitable retained habitat due to lack of connecting habitat and/or the presence of barriers that would inhibit the dispersal of dormice. Areas of suitable habitat within Southern Valley Golf Club, the eastern side of Claylane Wood and some areas of suitable habitat between the A2 carriageways and the A2 and HS1 rail line would be subject to capture and soft release measures (see CoCP (Application Document 6.3, Appendix 2.2), REAC Ref. TB016). Captured dormice would be released within two receptor sites: Shorne Woods Country Park and the northern boundaries of Ashenbank Woods/Jeskyns Country Park. The receptor areas would be subject to enhancement works to maximise foraging and shelter/breeding opportunities for dormice. Work to enhance the quality of the habitats for dormice within Shorne Woods Country Park (part of Shorne and Ashenbank Woods SSSI) has already been consented by Natural England. Kent County Council, through their ranger team at the Country Park, started this consented work in May 2022 to maximise the period of establishment prior to any impacts occurring as a result of the Project. The enhancement works include native woodland species planting to increase the diversity in food resource and woodland structure, changes to the coppice regime to optimise the value of the habitat, and removal of non-native invasive species. Dormouse nest boxes would also be erected in the receptor sites and retained vegetation (where possible) at a minimum density of 30 per ha to further increase the carrying capacity of these areas. The successful implementation, under an appropriate European Protected Species mitigation licence with respect to dormice (Appendix 8.18 (Application Document 6.3)), of the embedded mitigation measures described in Section 8.5 (species translocation, phased vegetation clearance, site supervision, habitat enhancement and habitat creation) would safeguard dormice and prevent the incidental injury or mortality of animals.

8.6.159 The creation of new areas of woodland would compensate for the loss of woodland habitat (see Figure 2.4: Environmental Masterplan (Application Document 6.2)) and Design Principles (Application Document 7.5) (Clause no. PRO.04, PLA.05, STR.01, S1.14, S1.04, S2.04). A post-construction monitoring programme would be undertaken to monitor the success of the licensable works and to inform future management and potential remedial measures (see CoCP (Application Document 6.3, ES Appendix 2.2). REAC Ref. TB015). The majority of compensatory habitat creation for dormouse would comprise woodland planting, located around the A2 corridor, with links between Great Crabbles Wood and Shorne Woods Country Park. The ancient woodland at Claylane Wood will also be linked to Shorne Woods Country Park with woodland planting either side of the Project and across the Thong Lane green bridge north. Woodland planting is also proposed to the west of Jeskyns Country Park. These

areas will be linked via the proposed green bridges (see Figure 2.4: Environmental Masterplan (Application Document 6.2)) and Design Principles (Application Document 7.5) Clause no. PRO.04, PLA.05, STR.01, S1.14, S1.04, S2.04).

8.6.160 The Project design and mitigation measures further described in Section 8.5 would result in habitats of greater connectivity and quality for dormouse in the medium to long term (after approximately five to 10 years of the habitat being created), which would maintain the favourable conservation status of the dormouse populations. The initial level of impact of habitat loss on dormouse would become reversible temporary negligible adverse at the opening year of the Project given the habitat creation proposed, changing to permanent minor beneficial after approximately 10 years. Given the timescale between initial habitat loss and new habitat establishing, the effects of habitat loss on the dormouse population, which is of county importance, are considered to be slight adverse and **not significant**.

8.6.161 **Direct mortality:** Dormouse are vulnerable to habitat clearance that might damage or destroy their nests during summer, or hibernation sites on the ground in winter.

8.6.162 The successful implementation of the mitigation measures described in Section 8.5 fencing, careful timing of vegetation clearance and ECoW supervision) would safeguard dormice and prevent the incidental injury or mortality of animals. The level of impact on the dormouse population, which is of county importance, would therefore be no change, resulting in effects that are neutral and **not significant**.

8.6.163 **Disturbance**: Noise, vibration, and visual disturbance during construction can have detrimental effects on dormouse, affecting their movement within retained habitats.

8.6.164 The successful implementation of the mitigation measures described in Section 8.5, including the management of light spill during construction to prevent artificial light impacting important retained habitats such as woodland, would safeguard dormouse from significant levels of disturbance such that the favourable conservation status of the population would be maintained (see Appendix 8.15: Construction and Operational Light Spill Calculations (Application Document 6.3)). The level of impact on the dormouse population, which is of county importance, would be reversible temporary negligible adverse, resulting in effects that are slight adverse and **not significant**.

8.6.165 **Habitat fragmentation**: Dormouse are highly sensitive to habitat and population fragmentation. The existing A2 constitutes a significant barrier to dispersal of dormice and the Project is not considered likely to exacerbate that situation. Habitat fragmentation could however occur between woodland either side of the Project as it heads north towards the River Thames, such as between Claylane Wood and the complex of woodland near Shorne.

8.6.166 Biodiversity connectivity south of the River Thames would be maintained by constructing mixed use green bridges crossing the Project (see Section 8.5). Green bridges have been shown to be used by dormice, as evidenced by dormice using the green bridge over the A21 at Scotney Castle (Natural England, 2015). In total three green bridges will be constructed, this includes Thong Lane green bridge north, which would consist of a two-lane road with

large southern and northern green verges that include hedgerow planting connecting to woodland either side of the route alignment. Thong Lane green bridge south would include a green verge to the west with a double hedgerow character, and a smaller green verge to the east with a single hedge line and a connecting mammal culvert under the connector road to the south of the green bridge. This green bridge would allow species to cross over the A2/M2 and link the north and south sides of Shorne and Ashenbank Woods SSSI. Although this green bridge is designed for multiple species, it is primarily designed to connect the dormouse populations present either side of the A2/M2. The Brewers Road green bridge has also been designed with a double hedgerow and single hedgerow either side of a two-lane carriageway, which would allow species, including dormouse, to cross from the woodland north of the A2/M2 to the parkland south of the A2/M2. To further increase the connectivity, a mammal culvert will be provided at the north end of the bridge between the existing and new bridge abutments. The culvert will be designed to allow mammal passage and will be designed to integrate into the surrounding environment (Design Principles (Application Document 7.5) Clause no. PRO.04, PLA.05, STR.01, S1.14, S1.04, S1.23, S2.04, S2.15).

8.6.167 Hedgerow habitat losses would be compensated by creating new hedgerows using locally occurring species. This would include particular focus on maintaining and improving hedgerows in the vicinity of the proposed green bridges (Design Principles (Application Document 7.5) (Clause no. PRO.04, PLA.05, STR.01, LSP.13, LSP.14)) and Figure 2.4: Environmental Masterplan (Application Document 6.2).

8.6.168 Although the loss of woodland habitat would be irreversible, the landscape planting has also been designed to provide connectivity with the wider landscape through a range of habitat creation measures, including extensive woodland planting linking Great Crabbles Wood and Shorne/Brewers Woods. This would increase the extent of the woodland habitat to the south of the River Thames, therefore extending the area of suitable habitat for colonisation by dormouse. Such measures would be likely to improve the conservation status of dormouse within the study area in the long term (after approximately 10 years).

8.6.169 In the short term, the Project could result in the fragmentation of habitats and limit the dispersal of animals from east to west across the Order Limits. However, the successful implementation of the Project design and mitigation measures described in Section 8.5 and as shown in Figure 2.4: Environmental Masterplan (Application Document 6.2) would provide habitats that are of greater quality and connectivity for dormouse. Given the landscape planting proposed, it is considered that the fragmentation impact would be reversible, and at the opening year of the Project, it is likely that there would be a temporary negligible adverse impact on dormouse. After approximately 10 years, this would improve to a permanent major beneficial level of impact on the dormouse population, which has county-level importance. Overall, the effect on dormice would be a slight beneficial effect that is **not significant**.

Water voles

8.6.170 The likely effects of construction would be:

a. Habitat loss

b. Disturbance
c. Direct mortality
d. Habitat fragmentation
e. Habitat degradation

8.6.171 **Habitat loss**: The construction of the ground protection tunnel would result in the temporary loss of 50m of confirmed water vole habitat in the Thames and Medway Canal (W059), and a further 200m from watercourses directly adjacent to the north of the Thames and Medway Canal (W055, W056, W058 and W237). The work on the Thames and Medway Canal (W059) would involve temporarily removing vegetation along the north bank. The works to W055 would include the diversion of the watercourse which would result in the new watercourse being approximately 50m longer than at present. The loss of habitat at W056, W058 and W237 is due to the construction of a compound and upgrading of a culvert. After construction, the vegetation along W059 would be reinstated to provide high quality water vole habitat. Watercourse W055 would be reinstated to its previous condition, and sections of the diverted channel would be retained, permanently increasing the overall length of the watercourse. In addition, the site of the ground protection tunnel construction compound would be reinstated to create additional slow-flowing ditch and pond habitat suitable for water voles, with a creation of over 500m of a suitable habitat.

8.6.172 The habitat creation as detailed in Figure 2.4: Environmental Masterplan (Application Document 6.2), and the Design Principles (Application Document 7.5) Clause no. S9.13, and the reinstatement of the existing watercourses, would ensure that any temporary loss of water vole habitat would be compensated, with an overall permanent net gain of over 550m in suitable habitat being provided.

8.6.173 The overall level of impact of habitat loss on the water vole populations, which are regionally important, would therefore be reversible temporary negligible adverse and result in effects that would be slight adverse and **not significant.**

8.6.174 **Disturbance:** Water vole presence has been confirmed within and adjacent to the Order Limits and disturbance is likely to occur during the construction phase. The potential for disturbance effects is most notable within the watercourses adjacent to the Metropolitan Police firing range, although this area is already subject to a high degree of background disturbance. Working measures including fencing-off retained watercourses, as detailed within the CoCP (Application Document 6.3, ES Appendix 2.2), and described in Section 8.5, would reduce the magnitude and extent of the likely disturbance impacts on water vole. Where water vole are present, measures to avoid disturbance would be incorporated into a Natural England conservation licence (Application Document 6.3, Appendix 8.20). With suitable mitigation measures in place, any disturbance impacts would be temporary and reversible and would not affect the conservation status of the water vole populations.

8.6.175 The overall level of impact of disturbance on the water vole populations, which are regionally important, would be temporary negligible adverse and result in effects that would be slight adverse and **not significant**.

8.6.176 **Direct mortality**: The construction of the Project may result in the direct mortality of water voles during bankside vegetation clearance and watercourse

realignment. Suitable working practices of pre-construction surveys, fencing-off retained habitats and displacing water vole from construction areas associated with watercourses, have been detailed in Section 8.5 and Appendix 8.20: Draft water vole conservation licence application (Application Document 6.3). These would be implemented within these areas to prevent injury or mortality to water voles during construction.

8.6.177 Impacts on the water vole populations, which are regionally important, from direct mortality would be avoided through the mitigation referenced above, resulting in a 'no change' level of impact. The effects on water vole would therefore be neutral and **not significant**.

8.6.178 **Habitat fragmentation**: The diversion of watercourse W055 would create a temporary barrier to water vole movement while the riparian vegetation along the diverted length establishes; a period estimated to be between 12 and 18 months. However, watercourse W055 connects into several other watercourses both to the east and the west of the diversion area, allowing movement of animals across this area. Considering the small-scale and temporary nature of the loss of habitat within W055, and the retention of connecting watercourses within the wider area, it is not envisaged that the conservation status of the population would be impacted (see Figure 2.4: Environmental Masterplan (Application Document 6.2).

8.6.179 The overall level of impact on the water vole populations, which are regionally important, would therefore be reversible temporary negligible adverse and result in slight adverse effects that would be **not significant**.

8.6.180 **Habitat degradation**: Accidental pollution events during construction may cause long-term impacts to water vole habitats. This may result in habitat degradation, particularly if such events reduced the extent and diversity of the aquatic vegetation that water vole rely on, and which requires good water quality. The rainwater runoff from the South Portal has been designed to flow into the Thames Estuary and Marshes Ramsar site and South Thames Estuary and Marshes SSSI, following pollution prevention controls (see Section 8.5). The flow will be regulated to ensure the discharge flow rates are managed at greenfield runoff rates.

8.6.181 The tunnels associated with the Project would extend beneath the Thames Estuary and Marshes Ramsar site and South Thames Estuary and Marshes SSSI at Filborough Marshes. Construction of the main tunnels and the ground protection tunnel has the potential to lead to reduced water levels within the ditch system associated with the designated site and therefore negatively impact water vole through loss of wetted area. However, groundwater level data from boreholes within the Ramsar site indicates that there is insufficient hydraulic head difference to drive net flow from the study area to the lower strata (see Appendix 14.5 (Application Document 6.3)). The lack of connection between the groundwater and the surface water would mean that there would be no impact on the water levels within the watercourse south of the river. The impact on the water vole would therefore be avoided.

8.6.182 Following the implementation of the Project mitigation measures referred to above, the level of impact of habitat degradation on the regionally important water vole population would be no change and result in effects that would be neutral and **not significant.**

Otters

8.6.183 The population of otter within the ZoI to the south of the River Thames is considered to be of no more than local importance, given the lack of evidence to suggest their presence in notable numbers.

8.6.184 The likely effects of construction would be:

a. Habitat loss

b. Direct mortality

c. Disturbance

d. Habitat degradation

e. Habitat fragmentation

8.6.185 **Habitat loss**: The construction of the ground protection tunnel would result in the temporary loss of 50m of watercourse in the Thames and Medway Canal (W059), and a further 200m from watercourses directly adjacent to the north of the Thames and Medway Canal (W055, W056, W058 and W237). Otters are unlikely to be resident within this area, although could potentially use this catchment. The work on the Thames and Medway Canal (W059) would involve temporarily removing vegetation along the north bank. The works to W055 would include the diversion of the watercourse which would result in the new watercourse being approximately 50m longer than at present. The loss of habitat at W056, W058 and W237 is due to the construction of a compound and upgrading of a culvert. After construction, the vegetation along W059 would be reinstated to provide high-quality riparian habitat. Watercourse W055 would be reinstated to its previous condition, and sections of the diverted channel would be retained, permanently increasing the overall length of the watercourse. In addition, the site of the ground protection tunnel construction compound would be reinstated to create additional slow-flowing ditch and pond habitat suitable for use by otter.

8.6.186 The habitat creation as detailed in Figure 2.4: Environmental Masterplan (Application Document 6.2) would ensure that any temporary loss of otter habitat would be compensated for, with an overall net gain in suitable habitat being provided.

8.6.187 The overall level of impact of habitat loss on the otter populations, which are locally important, would therefore be reversible temporary negligible adverse and result in effects that would be neutral and **not significant**.

8.6.188 **Direct mortality**: No potential otter lying-up sites were identified within the study area south of the River Thames. However, the construction of the Project would involve activities that may, in the absence of mitigation, result in the direct mortality of otter, including works associated with the diversion of a watercourse and removal of bankside vegetation. Suitable working practices including pre-construction surveys and fencing-off retained habitat have been detailed in Section 8.5 which would be implemented to prevent injury or mortality of otters during construction.

8.6.189 The level of impact on the otter populations, which are of local importance, would therefore be no change and result in effects that would be neutral and **not significant**.

8.6.190 **Disturbance**: No potential otter lying-up sites were identified within the study area south of the River Thames. Working measures including fencing-off areas, and if necessary species licensing, detailed within the CoCP (Application Document 6.3, ES Appendix 2.2) and described in Section 8.5, would be implemented to safeguard otter and their resting sites from disturbance, should they be present within the study area at the time of construction. This would include the employment of an ECoW to monitor potentially suitable habitat for use by otter during construction (CoCP (Application Document 6.3, ES Appendix 2.2) REAC Ref. TB006), and the implementation of any additional mitigation measures that might be necessary to safeguard otter, which could include obtaining a protected species mitigation licence from Natural England.

8.6.191 With suitable mitigation measures in place, disturbance would be temporary negligible adverse and, as such, the overall effects on otter, which are locally important, would be neutral and **not significant**.

8.6.192 **Habitat degradation**: Accidental pollution events during construction may cause long-term impacts to otter habitats. This may result in habitat degradation, particularly if such events reduced the extent and diversity of the aquatic vegetation, and therefore reduced the prey species of otter, which require good water quality. The rainwater runoff from the South Portal has been designed to flow into the Thames Estuary and Marshes Ramsar site and South Thames Estuary and Marshes SSSI following pollution prevention controls (see Section 8.5). The flow will be regulated to ensure the discharge flow rates are managed at greenfield runoff rates.

8.6.193 The tunnels associated with the Project would extend beneath the Thames Estuary and Marshes Ramsar site and South Thames Estuary and Marshes SSSI at Filborough Marshes. Construction of the main tunnels and the ground protection tunnel has the potential to lead to reduced water levels within the ditch system associated with the designated site and therefore negatively impact otter through loss of wetted area. However, groundwater level data from boreholes within the Ramsar site indicates that there is insufficient hydraulic head difference to drive net flow from the study area to the lower strata (see Appendix 14.5 (Application Document 6.3)). The lack of connection between the groundwater and the surface water would mean that there will be no impact on the water levels within the watercourse south of the river.

8.6.194 The level of impact on the otter populations, which are of local importance, would therefore be no change and result in effects that would be neutral and **not significant**.

8.6.195 **Habitat fragmentation**: The diversion of watercourse W055 would create a relatively short section of watercourse without established riparian vegetation for a period estimated to be between 12 and 18 months. However, this is not anticipated to be a significant barrier to otter movement, and watercourse W055 connects into several other watercourses both to the east and the west of the diversion area, allowing movement of animals across the catchment. Considering the small-scale and temporary nature of the loss of habitat within

W055, and the retention of connecting watercourses within the wider area, it is not envisaged that the conservation status of the population would be impacted (see Figure 2.4: Environmental Masterplan (Application Document 6.2).

8.6.196 The overall level of impact on the otter populations, which are locally important, would therefore be reversible temporary negligible adverse and result in neutral effects that would be **not significant**.

Badgers

8.6.197 The badger population within the ZoI to the south of the River Thames is considered to be of local importance.

8.6.198 The likely effects of construction on badger would be:

a. Habitat loss

b. Direct mortality

c. Disturbance

d. Habitat fragmentation

8.6.199 **Habitat loss**: To the south of the River Thames one active main sett would be lost as the result of the Project. To compensate for this, an artificial sett would be created prior to construction activities commencing and the closure of the existing sett. In addition to this, nine subsidiary setts and 12 outlier setts currently occupied by badgers will need to be closed under licence. All active badger sett closures would be undertaken under a development licence granted by Natural England (Appendix 8.19 (Application Document 6.3)).

8.6.200 In addition to the loss of these setts, some areas of foraging habitat would be lost due to the construction of the Project. The successful implementation of the Project design and mitigation measures described in Section 8.5 in relation to landscape-scale habitat creation would result in better quality and greater connectivity for badger, which would include the provision of new planted corridors that link retained areas of woodland. Such measures would compensate for the adverse impacts associated with habitat loss such that the residual impact would be negligible. The level of impact of habitat loss on badger, which are locally important, would therefore be reversible temporary negligible adverse and result in effects that would be neutral and **not significant**.

8.6.201 **Direct mortality and disturbance**: Construction activities may result in the disturbance or direct mortality of badger located within setts. To avoid this, suitable working methodologies would be employed to ensure that any works within close proximity to any retained setts, or any setts being closed under licence, would avoid any direct mortality of badger (as detailed in Appendix 8.19: Draft badger development licence application (confidential) (Application Document 6.3). Any retained setts would be monitored to ensure that disturbance does not affect the use of the sett (see the CoCP (Application Document 6.3, ES Appendix 2.2)). The level of impact of direct mortality and disturbance on badger, which are locally important, would therefore be

reversible temporary negligible adverse and result in effects that would be neutral and **not significant**.

8.6.202 **Habitat fragmentation**: The Project would result in fragmentation of habitat to the south of the River Thames. The provision of three green bridges, one over the route alignment, and a further two over the A2/M2 existing road, would ensure that safe commuting routes are provided for badger across the Project. The green bridges over the A2/M2 would replace existing road bridges and would enhance the existing connectivity in the wider environment. The level of impact of habitat fragmentation on badger, which are locally important, would therefore be reversible temporary negligible adverse and result in effects that would be slight adverse and **not significant**.

River Thames

Statutory designated sites

8.6.203 The likely effects of construction on ecological receptors include the following:

a. Habitat loss – direct loss of habitat as a result of construction

b. Direct mortality – construction activities causing direct mortality

c. Fragmentation – preventing animals dispersing and moving within the wider landscape

d. Habitat degradation – causing the habitat to become suboptimal, e.g. through pollution events, etc.

e. Disturbance – noise and visual disturbance of species present, including from anthropomorphic influences

8.6.204 Habitat degradation and disturbance of species present within statutory designated sites within the River Thames study area from increased visitor pressure has been considered as part of the assessment of likely construction effects. The same conclusions are drawn as outlined in paragraph 8.6.5 for statutory designated sites to the south of the River Thames, where impacts to the biodiversity resources within sites are not predicted, since recreational use is unlikely to change considerably. Therefore, likely significant effects on statutory designated sites within the River Thames study area would not occur during construction as a result of increased visitor pressure. Further details regarding the likely changes in recreational user activity during the construction phase are provided in Chapter 13: Population and Human Health. An assessment of the likely significant effects on individual statutory designated sites is considered further below.

Thames Estuary and Marshes SPA and Ramsar

8.6.205 The likely effects on the Thames Estuary and Marshes SPA and Ramsar site and associated bird assemblages within the River Thames study area, during the construction phase would be:

a. Habitat loss

b. Direct mortality

c. Disturbance

d. Habitat degradation

8.6.206 **Habitat loss**: There is no direct habitat loss from the Thames Estuary and Marshes SPA or Ramsar sites. The following areas of construction will result in the loss of habitat that is functionally linked to the SPA/Ramsar site that is primarily used by overwintering birds for foraging.

a. Intertidal habitat loss

b. Northern tunnel entrance compound temporary drainage pipeline and outfall

c. Coalhouse Point habitat creation area water inlet with self-regulating valve or equivalent structure

d. Coastal grassland/agricultural habitat loss

e. A226 Gravesend Road compound, Milton compound and the northern tunnel entrance compound

f. Construction of the drainage discharge and treatment array for the southern tunnel entrance compound

g. Construction haul roads, access and utilities diversions contiguous with their respective construction works areas

h. Highway works north of, and including, Tilbury Viaduct

8.6.207 The northern tunnel entrance compound temporary drainage pipeline and outfall would comprise a pipeline buried within the intertidal zone, terminating at an outfall structure of pre-cast concrete of approximately 2.5m by 4m providing a subtidal discharge point. The discharge pipeline will extend 300–400m across the intertidal zone and would require a 2m-wide piled trench, and a working width of approximately 10m resulting in the temporary direct loss of approximately 0.4ha. The outfall structure itself would result in the direct loss of approximately 0.001ha. This habitat loss would be temporary, apart from the permanent outfall structure, which has a negligible impact on the availability of habitat for foraging birds. This site is over 1km from the large aggregations of birds found to the south and east of Coalhouse Fort. The shifting nature of the estuarine habitat would lead to natural reinstatement of the mudflats and sandbanks rapidly after the completion of the works.

8.6.208 The water inlet with self-regulating valve or equivalent structure would be installed to the south-east of Coalhouse Fort to ensure a tidal water supply to a new area of habitat creation targeted specifically at wetland birds (see Figure 2.4: Environmental Masterplan (Application Document 6.2). This habitat creation area would consist of wet grassland, ditches and scrapes particularly suitable for birds found within the River Thames, particularly those associated with the Thames Estuary and Marshes SPA/Ramsar. The structure would be permanently constructed within the sea wall on the north bank of the River Thames, and a temporary construction zone would extend approximately 40m

into the intertidal zone and will lead to the temporary loss of approx. 0.2ha. This work is scheduled to take three months. This work is located at over 300m from the main aggregation of birds to the south and southeast of Coalhouse Fort.

8.6.209 The habitat loss of functionally linked habitat due to the A226 Gravesend Road compound, Milton compound and the northern tunnel entrance compound, construction of the drainage discharge and treatment array for the southern tunnel entrance compound, construction haul roads, access and utilities diversions contiguous with their respective construction works areas and the highway works north of, and including, Tilbury Viaduct will result in the temporary loss of approximately 285ha of coastal grassland and agricultural land used by overwintering birds. Of the 285ha, approximately 59ha of functionally linked habitat will be permanently lost.

8.6.210 The addition of the new habitat creation area of wet grassland, ditches and scrapes at Coalhouse Point, to the west of Coalhouse Fort, and the change in management of three fields south of the Metropolitan Police firing range to provide enhanced functionality of the functionally linked land during the construction period, would provide alternative foraging habitat as mitigation for these works (see Figure 2.4: Environmental Masterplan (Application Document 6.2), Design Principles (Application Document 7.5) Clause no. S9.13), and REAC commitment HR007 (Application Document 6.3, Appendix 2.2). With the reversible temporary nature of the works, and the small area of permanent habitat loss, the level of impact on the SPA and Ramsar and the associated bird assemblage is temporary negligible adverse, and results in an effect that is slight adverse and **not significant**.

8.6.211 **Direct mortality**: Nesting birds (the adult birds, nests, eggs and dependent young) are vulnerable to works occurring in close proximity that might damage or destroy a nest site during breeding (March to August inclusive). Nesting birds within the River Thames are likely to be limited, but waders nesting above the high tide line may occur. Implementation of the embedded and good practice mitigation measures (fencing and supervision of works) described in Section 8.5 and the REAC (Appendix 2.2 (Application Document 6.3), REAC Ref. TB004) would avoid such impacts and would provide protection for birds and their nests throughout the construction phase. The resultant effects would therefore be temporary negligible adverse and result in effects that would be neutral and **not significant** on nesting birds within the River Thames.

8.6.212 **Disturbance**: It is considered that the location of the tunnel boring operations is sufficiently far below ground that any noise and vibrations caused by the tunnel boring activities are not likely to result in any adverse effects on birds within the River Thames study area.

8.6.213 The noise and vibration associated with the above-ground Project construction works may disturb birds using the habitats within the SPA/Ramsar site and associated functionally linked land. Project construction works that would disturb the birds would be within the A226 Gravesend Road compound, Milton compound and the northern tunnel entrance compound and when constructing the temporary drainage discharge for the southern tunnel entrance compound, the northern tunnel entrance compound temporary drainage pipeline and outfall and the water inlet with self-regulating valve or equivalent structure at Coalhouse Point (see Chapter 12: Noise and Vibration and Habitats

Regulations Assessment – Screening Report and Statement to Inform an Appropriate Assessment (Application Document 6.5)).

8.6.214 To mitigate the potential disturbance when constructing the new South Portal construction drainage discharge, the northern tunnel entrance compound temporary drainage pipeline and outfall, the permanent outfall for the operational tunnel drainage and the water inlet with self-regulating valve or equivalent structure at Coalhouse Point, the timing of the works would be scheduled to avoid the peak aggregations of birds, particularly in the winter and passage seasons (Application Document 6.3, Appendix 2.2), REAC Ref. HR001, HR002, HR011, HR012).

8.6.215 Noise attenuation measures associated with the compounds would be provided to reduce any change in noise within the Thames Estuary and Marshes SPA/Ramsar site and associated functionally linked land (Application Document 6.3, Appendix 2.2), REAC Ref. HR004, HR005). Additionally, the installation of these measures are also seasonally constrained to avoid disturbing birds during the passage and winter period (REAC Ref. HR005, HR006). The Project has committed to the provision of an ECoW (REAC Ref. TB006) and monthly bird survey surveillance visits between 1 July and 30 April inclusive during each year of the Project construction period to observe any behaviours in response to disturbance stimuli and investigate and review mitigation in consultation with Natural England (REAC Ref. HR009).

8.6.216 It is considered that the level of impact of disturbance on SPA/Ramsar bird assemblage during construction would be reversible temporary negligible adverse and result in an effect that is slight adverse and **not significant**.

8.6.217 **Habitat degradation**: the Project would install drainage systems to remove surface water from the construction area. To mitigate the potential for degradation of designated and functionally linked habitats of the Thames Estuary and Marshes SPA and Ramsar site, the Project has committed to a number of embedded measures associated with construction drainage to manage the risks of water pollution during the construction phase. These are described within Chapter 2: Project Description.

8.6.218 At the southern tunnel entrance compound, due to the size of the site, rainwater runoff cannot be managed by the methods described above and in order to effectively treat the water to meet discharge consent standards, a full collection and management regime would be implemented before discharging to the ditch network forming part of the Thames Estuary and Marshes Ramsar site. The flow would be regulated to ensure the discharge flow rates are managed at greenfield runoff rates. At the northern tunnel entrance compound, there would be similar issues as at the southern tunnel entrance compound regarding management of rainwater runoff. The approach described above would be followed for rainwater harvesting and the collection and treatment of water, prior to discharge. As at the southern tunnel entrance compound, a series of treatment ponds/lagoons and weirs would be constructed within the Order Limits. The water from the treatment process in the northern tunnel entrance compound would be pumped into a new outfall pipe and then subsequently discharged into the River Thames.

8.6.219 Good practice measures would be implemented via the CoCP (Application Document 6.3, Appendix 2.2), REAC Ref. RDWE033), to manage the risks of water pollution during the construction phase. The committed measures are all established good practice methods designed to avoid water pollution. These methods are considered to be effective at managing the risk and are defined in many industry standards for use on construction sites, for example, Control of Water Pollution from Construction Sites (C532), (Masters-Williams *et al.*, 2001).

8.6.220 It is considered that the level of impact of habitat degradation on the Thames Estuary and Marshes Ramsar site and the functionally linked land associated with the SPA/Ramsar site during construction would be temporary negligible adverse and result in an effect that is slight adverse and **not significant**.

8.6.221 A further assessment of habitat degradation can be found within the Habitats Regulations Assessment – Screening Report and Statement to Inform an Appropriate Assessment (Application Document 6.5). The assessment concluded that there is sufficient evidence to demonstrate beyond reasonable scientific doubt that the Project (alone and in combination with other plans and projects) would not adversely affect the integrity of the Thames Estuary and Marshes SPA and the Thames Estuary and Marshes Ramsar. Therefore, the likely effects would be **not significant**.

Otters

8.6.222 The otter population within the study area associated with the River Thames is considered to be of local importance.

8.6.223 Drainage from the northern tunnel entrance compound is proposed to discharge into the River Thames from the north side. The design of the discharge pipeline and outfall to the River Thames would provide for a subtidal mid-water discharge for effective dilution and dispersal, and to reduce disturbance to the intertidal zone. Additionally, a tidal sluice gate would be constructed to regulate the flow of water into an area of mitigation to the west of Coalhouse Fort. Any potential adverse impacts on otters associated with the construction of the pipeline, outfall and tidal sluice gate, including disturbance, habitat loss and habitat degradation would be highly localised and limited to the immediate vicinity of the pipeline, outfall and tidal sluice gate. The extent of the impact would be very small compared to the amount of habitat that is available to otters in the wider context of the study area. Therefore, the level of impact would be unlikely to cause additional disturbance or loss of habitat to otters that could affect the conservation status of the otter population.

8.6.224 Overall, the level of impact of the Project on otter within the River Thames study area during construction would be reversible temporary negligible adverse and result in effects that would be neutral and **not significant**.

North of the River Thames

8.6.225 The likely effects of construction on ecological receptors include the following:

a. Habitat loss – direct loss of habitat as a result of construction

b. Direct mortality – construction activities causing direct mortality

c. Fragmentation – preventing animals dispersing and moving within the wider landscape

d. Habitat degradation – causing the habitat to become suboptimal, e.g. through pollution events, etc.

e. Disturbance – noise and visual disturbance of species present, including from anthropomorphic influences

Statutory designated sites

8.6.226 The likely effects of construction on statutory designated sites include the following:

a. Habitat loss – for sites that are located or partly located within the Order Limits

b. Habitat degradation – direct and indirect effects including air quality and hydrology

c. Noise and visual disturbance of species present – for sites that are located or partly located within the Order Limits (with the exception of mobile species like birds or bats where these are a designated feature)

8.6.227 Habitat degradation and disturbance of species present within statutory designated sites to the north of the River Thames from increased visitor pressure has been considered as part of the assessment of likely construction effects. The same conclusions are drawn as outlined in paragraph 8.6.5 for statutory designated sites to the south of the River Thames, where impacts to the biodiversity resources within sites are not predicted, since recreational use is unlikely to change considerably. Therefore, likely significant effects on statutory designated sites to the north of the River Thames would not occur during construction as a result of increased visitor pressure. Further details regarding the likely changes in recreational user activity during the construction phase are provided in Chapter 13: Population and Human Health.

8.6.228 An assessment of the likely significant effects on individual statutory designated sites is considered further below.

Mucking Flats and Marshes SSSI

8.6.229 **Habitat degradation**: Mucking Flats and Marshes SSSI lies immediately adjacent to the Order Limits. Increased dust deposition and changes in water quality/quantity within surface waters during the construction phase would potentially result in a negative impact on the grazing marsh, saltmarsh, dykes and fleets, and mudflats for which the SSSI is designated. However, increased dust deposition, emissions from construction vehicles and Non-road Mobile Machinery, and accidental pollution events are unlikely following the implementation of good practice mitigation measures (e.g. dust suppression and control of runoff) to manage such impacts as detailed in the CoCP (Application Document 6.3, ES Appendix 2.2) and described in Section 8.5 and Section 5.5 of Chapter 5: Air Quality.

8.6.230 Construction of the main tunnels has the potential to lead to reduced water levels within the ditch system associated with the designated site and therefore negatively impact flora and fauna through loss of wetted area. However, as for the south of the River Thames area, groundwater level data from boreholes within the Ramsar site indicates that there is insufficient hydraulic head difference to drive net flow from the study area to the lower strata, so an effect from a reduction in water levels is not anticipated (see Appendix 14.5 (Application Document 6.3)). Overall, impacts on Mucking Flats and Marshes SSSI, which is a nationally important site, are not predicted and effects are therefore considered to be neutral and **not significant**.

8.6.231 **Disturbance of species present**: The site is designated for supporting a large assemblage of wintering wildfowl and waders as well as a diverse invertebrate fauna. The possible construction effects on each individual species are discussed in the relevant species sections below. Disturbance impacts to species associated with the SSSI are not predicted. Therefore, the effect would be neutral and **not significant**. The conservation status of these species and the integrity of the SSSI would therefore be maintained as a result of the Project.

Hangman's Wood and Deneholes SSSI

8.6.232 No direct impacts on Hangman's Wood and Deneholes SSSI are anticipated during the construction phase, as the site is located 307m from the Order Limits.

8.6.233 **Habitat degradation**: Indirect impacts such as increased dust deposition, emissions from construction vehicles and Non-road Mobile Machinery or accidental pollution events are unlikely following the implementation of embedded mitigation measures (e.g. dust suppression and control of runoff) to manage such impacts as described in the CoCP (Application Document 6.3, ES Appendix 2.2), Section 8.5 and Section 5.5 of Chapter 5: Air Quality. This would avoid such impacts on the nationally important SSSI and result in effects that are considered to be neutral and **not significant**.

8.6.234 **Disturbance of species present:** The site is designated as a key underground hibernation site for bats. No direct or indirect disturbance of species is anticipated during construction, given the distance from construction works and the maintenance of connectivity to the site. There would therefore be no change, and the effects on the species for which the nationally important SSSI is designated would be neutral and **not significant**.

Linford Wood LNR

8.6.235 No direct impacts on Linford Wood LNR are anticipated during the construction phase, as the site is located in excess of 107m from the Order Limits.

8.6.236 **Habitat degradation**: Indirect impacts such as increased dust deposition, emissions from construction vehicles and Non-road Mobile Machinery or accidental pollution events are unlikely following the implementation of embedded mitigation measures (e.g. dust suppression and control of runoff) to manage such impacts as detailed in the CoCP (Application Document 6.3, ES Appendix 2.2) and described in Section 8.5 and Section 5.5 of Chapter 5: Air Quality. There would therefore be no change to the site, which is of county importance, and effects are considered to be neutral and **not significant**.

Cranham Marsh LNR

8.6.237 No direct impacts on Cranham Marsh LNR are anticipated during the construction phase, as the site is located in excess of 260m from the Order Limits.

8.6.238 **Habitat degradation**: Indirect impacts such as increased dust deposition, emissions from construction vehicles and Non-road Mobile Machinery or accidental pollution events are unlikely following the implementation of embedded mitigation measures (e.g. dust suppression and control of runoff) to manage such impacts as detailed in the CoCP (Application Document 6.3, ES Appendix 2.2) and described in Section 8.5 and Section 5.5 of Chapter 5: Air Quality.

8.6.239 Cranham Marsh LNR has been identified as containing GWDTE habitats (see Section 14.4 of Chapter 14: Road Drainage and the Water Environment). Following the mitigation measures provided in Section 14.5 of Chapter 14: Road Drainage and the Water Environment, the risk of impacts on the groundwater levels, and therefore the GWDTE habitats, have been assessed as unlikely.

8.6.240 There would therefore be no change to the site, which is of national importance, and effects are considered to be neutral and **not significant**.

Cranham Brickfields LNR

8.6.241 No direct impacts on Cranham Brickfields LNR are anticipated during the construction phase, as the site is located in excess of 226m from the Order Limits.

8.6.242 **Habitat degradation**: Indirect impacts such as increased dust deposition, emissions from construction vehicles and Non-road Mobile Machinery or accidental pollution events are unlikely following the implementation of embedded mitigation measures (e.g. dust suppression and control of runoff) to manage such impacts as detailed in the CoCP (Application Document 6.3, ES Appendix 2.2) and described in Section 8.5 and Section 5.5 of Chapter 5: Air Quality. There would therefore be no change to the site, which is of county importance, and effects are considered to be neutral and **not significant**.

Grays Thurrock Chalk Pit SSSI

8.6.243 No direct impacts on Grays Thurrock Chalk Pit SSSI are anticipated during the construction phase, as the site is located in excess of 1km from the Order Limits.

8.6.244 **Habitat degradation**: Indirect impacts such as increased dust deposition, emissions from construction vehicles and Non-road Mobile Machinery or accidental pollution events are unlikely following the implementation of embedded mitigation measures (e.g. dust suppression and control of runoff) to manage such impacts as detailed in the CoCP (Application Document 6.3, ES Appendix 2.2) and described in Section 8.5 and Section 5.5 of Chapter 5: Air Quality. There would therefore be no change to the site, which is of county importance, and effects are considered to be neutral and **not significant**.

Grove House Wood LNR

8.6.245 No direct impacts on Grove House Wood LNR are anticipated during the construction phase, as the site is located approximately 1.35km from the Order Limits.

8.6.246 **Habitat degradation**: Indirect impacts such as increased dust deposition, emissions from construction vehicles and Non-road Mobile Machinery or accidental pollution events are unlikely following the implementation of embedded mitigation measures (e.g. dust suppression and control of runoff) to manage such impacts as detailed in the CoCP (ES Appendix 2.2, Application Document 6.3) and described in Section 8.5 and Section 5.5 of Chapter 5: Air Quality. There would therefore be no change to the site, which is of county importance, and effects are considered to be neutral and **not significant**.

The Manor LNR

8.6.247 No direct impacts on The Manor LNR are anticipated during the construction phase, as the site is located approximately 1.14km from the Order Limits.

8.6.248 **Habitat degradation**: Indirect impacts such as increased dust deposition, emissions from construction vehicles and Non-road Mobile Machinery or accidental pollution events are unlikely following the implementation of good practice mitigation measures (e.g. dust suppression and control of runoff) to manage such impacts as detailed in the CoCP (Application Document 6.3, ES Appendix 2.2) and described in Section 8.5 and Section 5.5 of Chapter 5: Air Quality. There would therefore be no change to the site, which is of county importance, and effects are considered to be neutral and **not significant**.

Thorndon Park SSSI

8.6.249 No direct impacts on Thorndon Park SSSI are anticipated during the construction phase, as the site is located approximately 1.64km from the Order Limits.

8.6.250 **Habitat degradation**: Indirect impacts such as increased dust deposition, emissions from construction vehicles and Non-road Mobile Machinery or accidental pollution events are unlikely following the implementation of good practice mitigation measures (e.g. dust suppression and control of runoff) to manage such impacts as detailed in the CoCP (Application Document 6.3, ES Appendix 2.2) and described in Section 8.5 and Section 5.5 of Chapter 5: Air Quality. There would therefore be no change to the site, which is of national importance, and effects are considered to be neutral and **not significant**.

Nitrogen deposition impacts

8.6.251 There is potential for effects associated with increased nitrogen deposition on designated habitats within close proximity to the construction ARN from traffic emissions (see Section 5.5 of Chapter 5: Air Quality). These are detailed in Appendix 8.14: Designated Sites Air Quality Assessment (Application Document 6.3), which considers the effects of nitrogen deposition on designated sites that require further consideration in line with DMRB LA 105 Air Quality (Highways England, 2020b). No statutory sites were identified for further consideration, but 16 non-statutory sites were screened in for assessment. A summary table of the conclusions of Appendix 8.14 (Application Document 6.3)

is presented in Table 8.37 below. Where sites are affected by both construction and operational increases in nitrogen deposition, these are addressed in the operational assessment section of this chapter and have been highlighted accordingly. This is to take into account the cumulative durational effect of sites experiencing increased nitrogen deposition during both the construction and operational phase of the assessment.

Non-statutory designated sites

8.6.252 A total of 63 non-statutory designated sites are located within 500m of the Order Limits to the north of the River Thames. An additional seven non-statutory designated sites have also been considered as part of this assessment, since they are likely to be hydrologically linked to the Project.

8.6.253 Habitat degradation and disturbance of species present within non-statutory designated sites from increased visitor pressure has been considered as part of the assessment of likely construction effects. The same conclusions are drawn as outlined in paragraph 8.6.5 for statutory designated sites to the south of the River Thames, with reference to Chapter 13: Population and Human Health, where further consideration is given to the likely changes in the activity of recreational users within the ZoI. Therefore, likely significant effects on the biodiversity resources within non-statutory designated sites to the north of the River Thames would not occur during construction as a result of increased visitor pressure.

8.6.254 An assessment of the likely significant effects on individual non-statutory designated sites is considered further below.

Low Street Pit LWS

8.6.255 Habitat loss would occur within the LWS, totalling 3.52ha (99% of the site). This would result in the associated loss of notable plant and invertebrate populations including the permanent loss of 0.62ha of unimproved acid grassland. To compensate for this loss, over 60ha of habitat would be created within close proximity to the existing grassland, including an area of acid grassland translocation. A management plan outlined in the third iteration of Figure 2.4: Environmental Masterplan (Application Document 6.2) would be implemented to manage the ongoing success of this grassland. The possible construction effects on invertebrates are discussed in the relevant section below (see paragraphs 8.6.289 to 8.6.304). However, the loss of the site, which is of county importance, would result in an irreversible permanent major adverse level of impact and a moderate adverse effect that is **significant**.

Blackshots Nature Area LWS

8.6.256 Habitat loss within the site would impact 12.34ha (68%) of the habitats present, including the loss of semi-improved neutral grassland. Associated loss of important invertebrate populations and nesting habitat for birds would also occur. To compensate for the loss of this area, 40ha of grassland habitat would be created as outlined in Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.22, PRO.04, PLA.05, LSP.02, LSP.04 and LSP.09. Possible construction effects on each individual species are discussed in the relevant species sections below.

8.6.257 As a result of this large-scale permanent habitat loss within the LWS, which is of county importance, an irreversible permanent major adverse level of impact would occur. This would result in a moderate adverse effect that is **significant**.

Rainbow Shaw LWS

8.6.258 There would be a loss of 1.2ha of ancient woodland representing 58% of the LWS. To compensate for this loss, 2ha of woodland planting described in Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.19, is proposed to the west of Rainbow Shaw. However, given the ancient status of this woodland, any habitat lost is considered to be irreplaceable. Habitat degradation due to possible pollution events and disturbance to badger, bats and nesting birds present within retained areas of the LWS would be mitigated by the inclusion of the good practice mitigation including alternative bat roost provision, temporary fencing of retained habitats, dust suppression and surface water runoff treatment as detailed in Section 8.5.

8.6.259 This would reduce the likely impacts such that the conservation status of the species associated with the designated site would be maintained. However, the loss of ancient woodland, which is considered to be nationally important, would adversely impact the integrity of the LWS and would represent an irreversible permanent major adverse level of impact that would result in a large adverse effect that is **significant**.

8.6.260 The likely effects on the remaining sites associated with the construction phase are outlined below in Table 8.33.They include the following:

a. Habitat loss – for sites that are located or partly located within the Order Limits

b. Habitat degradation – direct and indirect effects including air quality and hydrology

c. Noise and visual disturbance of species present – for sites that are located or partly located within the Order Limits

8.6.261 Project design and mitigation measures outlined in Section 8.5 would safeguard sites listed in Table 8.33 below with no direct impacts, from likely indirect effects during construction. This includes measures to reduce potential pollution due to runoff and air quality effects associated with construction dust, as well as emissions from construction vehicles and Non-road Mobile Machinery.

Table 8.33 Construction effects on non-statutory designated sites north of the River Thames

Designated site	Impacts, mitigation and overall likely effects
Tilbury Marshes LWS	Small area of habitat loss (0.83ha representing 2.1% of the LWS) in the northern part of the LWS where the site lies partially within the Order Limits. The habitat loss would be associated with a proposed underground utilities diversion and would be temporary in nature, affecting primarily open mosaic habitat comprising scrub, tall ruderal and grassland. Habitats of this nature would be expected to re-establish within two to five years following completion of the proposed works. Habitat degradation due to possible

Designated site	Impacts, mitigation and overall likely effects
	pollution events and temporary disturbance and displacement of species within the site could also occur. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would mitigate adverse impacts to a minor level, such that the integrity of the site and conservation status of the species associated with it would be maintained. This would result in reversible temporary negligible adverse impacts on this site, which is of county-level importance, and slight adverse effects that are **not significant**.
Goshems Farm LWS	No permanent loss of habitat designated within the LWS due to the workings of IVL. Loss of 59.6ha (representing 81% of the LWS) of habitat within the LWS boundary that would be restored as arable farmland under IVL's aspirational masterplan (D.K. Symes Associates, 2019). The creation of open mosaic habitat in this Tilbury Fields area, the habitat creation around Coalhouse Fort, as well as wetland habitat described in Section 8.5 and the Design Principles (Application Document 7.5) Clause no. LSP.22, PRO.04, PLA.05, LSP.02, LSP.04 and LSP.09 would compensate for the loss of arable land. Given the open mosaic habitat proposed as part of the Project would have a greater biodiversity value than the arable land proposed as part of the IVL aspirational masterplan, it is predicted that there would be a permanent minor beneficial impact in this area which would result in a slight beneficial effect that is **not significant**.
Tilbury Centre LWS	Small area of temporary habitat loss (0.03ha representing 1.1% of the LWS) in the north-east corner of the LWS where the site lies partially within the Order Limits. The loss would comprise scrub habitat along an existing access road and would be associated with the proposed underground diversion of utilities infrastructure and the construction of a construction access route, although neither would be sited directly within the LWS. Habitat degradation due to possible pollution events and disturbance to species, including the invertebrate population within the site. Good practice mitigation including temporary fencing of retained habitats, dust suppression and surface water runoff treatment as detailed in Section 8.5 would mitigate adverse impacts to a reversible temporary negligible level such that the integrity of the site and conservation status of the species associated with it would be maintained. This would result in effects on the site, which is of county-level importance, that are considered to be slight adverse and **not significant**.
Lytag Brownfield LWS	Lytag Brownfield LWS, which is of county importance, is currently subject to development from Tilbury2 hence significant impacts from habitat loss during construction from the Project are not anticipated. The Tilbury2 proposals are to remove the LWS, create offsite mitigation and retain 0.7ha of the site. Habitat degradation due to possible pollution events and disturbance to species could occur in the remaining habitat. Good practice and essential mitigation including translocation of species to the receptor site north of Coalhouse Fort (detailed in Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. S9.13), dust suppression and surface water runoff treatment as detailed in Section 8.5 would reduce the adverse impacts such that the integrity of the site and conservation status of the species associated with it would be maintained. This would result in a level of impact that is reversible temporary negligible adverse and effects that are considered to be slight adverse and **not significant**.

Designated site	Impacts, mitigation and overall likely effects
Broom Hill LWS	No direct habitat loss as the site is 135m from the Order Limits but there is the potential for habitat degradation due to possible pollution events. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would avoid this and ensure the integrity and conservation status of the site, which is of county importance, would be maintained. There would be no change to this site, and the effects of the construction phase would be neutral and **not significant**.
West Tilbury Hall LWS	No direct habitat loss as the site is 5m from the Order Limits but potential for habitat degradation due to possible pollution events. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would avoid this and ensure the integrity and conservation status of the site, which is of county importance, would be maintained. There would be no change to this site, and the effects of the construction phase would be neutral and **not significant**.
West Tilbury Church LWS	None – the LWS is located 120m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the LWS from likely indirect effects during construction. There would be no change to this site, and the effect of the construction phase would be neutral and **not significant**.
Terrel's Heath LWS and Chadwell ASNW	None – the LWS is located 18m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the LWS from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this nationally important site would be neutral and **not significant**.
Mucking Heath LWS	Permanent irreversible habitat loss (2.26ha representing 4.4% of the LWS) in the north-east and south-west of the LWS. The loss would be associated with heathland and acid grassland and would result in potential disturbance and displacement of invertebrate populations and other species within the LWS. Habitat creation described in Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.22, PRO.04, PLA.05, LSP.02, LSP.04 and LSP.09, would compensate for the losses. Habitat degradation due to possible pollution events could also occur. Good practice mitigation including temporary fencing of retained habitat, dust suppression and surface water runoff treatment as detailed in Section 8.5 would reduce the adverse impacts. Creation of open mosaic and grassland habitat described in Section 8.5 would compensate for the losses. Given the small extent of habitat loss, the integrity of the site and conservation status of the species associated with it would be maintained. The level of impact on the LWS, which is of county importance, would be permanent minor adverse. The subsequent effect is considered to be slight adverse and **not significant**.
Orsett Camp Quarry LWS	No direct habitat loss as the site is 3m from the Order Limits but potential for habitat degradation due to possible pollution events. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would avoid this and ensure the integrity and conservation status of the site, which is of county importance, would be maintained. There would be no change to this site, and the effects are considered to be neutral and **not significant**.
Linford Pit LWS	Small area of temporary brownfield habitat loss (0.51ha representing 3.5% of the LWS) in the south-west of the LWS and associated potential

Designated site	Impacts, mitigation and overall likely effects
	temporary disturbance and displacement to invertebrate populations and other species associated with the site. The impacts would be associated with proposed works to an existing overhead power line. Habitats of this nature would be expected to re-establish within two to five years following completion of the proposed works. Habitat degradation due to possible pollution events. Good practice mitigation including temporary fencing of retained habitats, dust suppression and surface water runoff treatment as detailed in Section 8.5 would reduce the adverse impacts such that the integrity of the site, which is of county importance, and conservation status of the species associated with it would be maintained. The level of the likely impacts is considered to be reversible temporary negligible adverse, resulting in slight adverse effects, which are **not significant**.
Linford Wood LWS	None – no construction activities are planned within the LWS which is located 106m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the LWS from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this LWS, which is of county importance, would be neutral and **not significant**.
Gobions Lake LWS	None – the LWS is located over 312m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the LWS from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this LWS, which is of county importance, would be neutral and **not significant**.
Buckingham Hill LWS	No direct habitat loss as the site is 11m from the Order Limits but potential for habitat degradation due to possible pollution events. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would avoid this and ensure the integrity and conservation status of the site, which is of county importance, would be maintained. There would be no change to this site, and the effects are considered to be neutral and **not significant**.
Woodlands School Meadow LWS	None – the LWS is located 219m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the site from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this LWS, which is of county importance, would be neutral and **not significant**.
Warley Hall Wood LWS and ASNW	None – the site is located 345m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the site from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this site, which is of national importance, would be neutral and **not significant**.
Mardyke LWS	None – the LWS is located 373m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the site from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this LWS, which is of county importance, would be neutral and **not significant**.

Designated site	Impacts, mitigation and overall likely effects
West of Arisdale Avenue LWS	No direct habitat loss as the site is 9m from the Order Limits but potential for habitat degradation due to possible pollution events. Good practice mitigation including temporary fencing, dust suppression and surface water runoff treatment as detailed in Section 8.5 would avoid this and ensure the integrity and conservation status of the nationally important site would be maintained. There would be no change to this site, and the effects of the construction phase would therefore be neutral and **not significant**.
Belhus Lakes/ Belhus Wood Country Park LWS	None – the site is located 465m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the site from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this LWS, which is of county importance, would be neutral and **not significant**.
Palmers Shaw LWS and Great Palmers Shaw ASNW	None – the site is located 476m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the site from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this LWS, which is of county importance, would be neutral and **not significant**.
Belhus Park East LWS; Oak Wood LWS and ASNW; Whitehall Wood ASNW; Brickkiln Wood ASNW/Belhus Wood Country Park LWS; Brickbarn Wood ASNW; Millard's Gardens/ Brannett's Wood LWS; Warwick Wood ASNW.	No habitat loss but possible pollution events due to these sites being hydrologically linked to the Project. Pollution prevention measures as detailed in the CoCP (Application Document 6.3, ES Appendix 2.2) and described in Section 8.5 would avoid any such pollution impacts associated with the construction phase. There would be no change to these sites, and the effect of the Project on them would be neutral and **not significant**.
St Nicholas Church LWS	None – the LWS is located 325m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the site from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this LWS, which is of county importance, would be neutral and **not significant**.
Stubber's Outdoor Pursuits Centre SINC	None – the SINC is within the Order Limits, however no habitat loss is predicted. The area within the Order Limits forms part of the bat mitigation as it will be used to deploy bat boxes. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the site from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this SINC, which is of county importance, would be neutral and **not significant.**
Ockendon Railsides SINC	Temporary reversible loss of an area of county value (0.67ha representing 5% of the SINC) within the southern area of the SINC, which is outside of the areas of ancient woodland. Woodland planting described in Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2) and the

Designated site	Impacts, mitigation and overall likely effects
	Design Principles (Application Document 7.5) Clause no. LSP.19 is proposed to compensate for this loss. There will also be associated disturbance and displacement of species associated with the site. Good practice mitigation including temporary fencing of retained habitat, dust suppression and surface water runoff treatment as detailed in Section 8.5 would reduce the likely impacts such that the conservation status of the species associated with the designated site would be maintained. The temporary loss of the habitats would not adversely impact the integrity of the SINC and would represent a temporary negligible level of impact. The subsequent effect would be slight adverse and **not significant**.
Thames Chase Forest Centre SINC	Permanent irreversible (2.34ha) and temporary reversible (11.0ha) loss of an area of county value (representing 6% and 28% of the SINC respectively) within the southern and eastern area of the SINC woodland. Woodland planting across an area of 12ha immediately south of the SINC, described in Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.02 and LSP.05 is proposed to compensate for this loss. There would also be associated disturbance and displacement of species associated with the site. Good practice mitigation including temporary fencing of retained habitat, dust suppression and surface water runoff treatment as detailed in Section 8.5 would reduce the likely impacts such that the conservation status of the species associated with the designated site would be maintained. Thames Chase Community Forest SINC has been identified as containing small and very discreet areas (less than 2m by 2m areas) of low groundwater dependent marginal habitats at Hobbs Hole (a pond at the southern extremity of the SINC), and the stream to the north of the site (see Section 14.4 of Chapter 14: Road Drainage and the Water Environment). Following the mitigation measures provided in Section 14.5 of Chapter 14: Road Drainage and the Water Environment, impacts on groundwater levels, and therefore at the pond, have been assessed as negligible. The loss of the habitats would adversely impact the integrity of the SINC and would represent a temporary moderate adverse impact. The subsequent effect would be slight adverse and **not significant**.
Cranham Marsh SINC	None – the SINC is located 259m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the site from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this SINC, which is of county importance, would be neutral and **not significant**.
Fields South of Cranham Marsh SINC	Area of habitat loss (0.01ha representing 0.04% of the SINC) along the eastern edge of the SINC, habitat degradation due to possible pollution events and possible disturbance to water vole and invertebrates. Habitat creation described in Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.22, PRO.04, PLA.05, LSP.02, LSP.04 and LSP.09 would compensate for this loss. Good practice mitigation including temporary fencing of retained habitat, dust suppression and surface water runoff treatment as detailed in Section 8.5 would reduce the adverse impacts such that the integrity of the site, which is of county importance, and conservation status of the species associated with it, would be maintained. The impact of the habitat loss would be reversible temporary negligible

Designated site	Impacts, mitigation and overall likely effects
	adverse, affecting primarily arable habitat on a temporary basis. The subsequent effect would be neutral and **not significant**.
North Ockendon Pit SINC	Area of temporary reversible habitat loss (1.39ha representing 7.3% of the SINC) within the southern half of the SINC and habitat degradation due to possible pollution events. Habitat creation described in Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.22, PRO.04, PLA.05, LSP.02, LSP.04 and LSP.09 would compensate for this loss. Good practice mitigation including temporary fencing of retained habitat, dust suppression and surface water runoff treatment as detailed in Section 8.5 would reduce the adverse impacts to retained habitats within the SINC. North Ockendon Pit SINC has been identified as containing GWDTE habitats (see Section 14.4 of Chapter 14: Road Drainage and the Water Environment). Following the mitigation measures provided in Section 14.5 of Chapter 14: Road Drainage and the Water Environment, impacts on groundwater levels, and therefore these GWDTE habitats, have been assessed as negligible. The impact of the habitat loss would result in a negligible temporary adverse level of impact and result in effects that are slight adverse and **not significant**.
Hall Farm Moat, Paddock and St Mary Magdalene Churchyard, North Ockendon SINC	No habitat loss as the site is not within the Order Limits. Habitat degradation due to possible pollution events. Good practice mitigation including temporary fencing of retained habitat, dust suppression and surface water runoff treatment as detailed in Section 8.5 would avoid this and ensure the integrity and conservation status of the site, which is of county importance, would be maintained. Hall Farm Moat SINC has been identified as containing small and very discreet areas (less than 2m by 2m areas) of low groundwater dependent marginal habitats in the ponds (see Section 14.4 of Chapter 14: Road Drainage and the Water Environment). Following the mitigation measures provided in Section 14.5 of Chapter 14: Road Drainage and the Water Environment, impacts on groundwater levels, and therefore the ponds, have been assessed as reversible temporary negligible. The effects are considered to be neutral and **not significant**.
Fairplay Farm SINC	None – the SINC is located 69m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the site from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this SINC, which is of county importance, would be neutral and **not significant**.
Cranham Hall Shaws and Pasture SINC	None – the SINC is located 386m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the site from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this SINC, which is of county importance, would be neutral and **not significant**.
Puddle Dock Angling Centre SINC	Small area of temporary habitat loss (0.04ha representing 0.3% of the SINC) along the western edge of the. SINC Habitat creation described in Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.19 is proposed to compensate for this loss. There is also the possible degradation and temporary disturbance of associated species within the site. Good practice mitigation including temporary fencing of retained

Designated site	Impacts, mitigation and overall likely effects
	habitat, dust suppression and surface water runoff treatment as detailed in Section 8.5 would minimise impacts such that the integrity of the county important site and conservation status of the species associated with it would be maintained. The impact would be reversible temporary negligible adverse and would be compensated by the proposed habitat creation outlined in Section 8.5. The subsequent effect would be slight adverse and **not significant**.
Clay Tye Wood ASNW	None – the woodland is located over 238m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the woodland and avoid likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this nationally important woodland would be neutral and **not significant**.
Franks Wood ASNW	No habitat loss as the site is not within the Order Limits. Habitat degradation due to possible pollution events. Good practice mitigation including temporary fencing of retained habitat, dust suppression and surface water runoff treatment as detailed in Section 8.5 would avoid this and ensure the integrity and conservation status of the site, which is of national importance, would be maintained. There would be no change to this site, and the effects are considered to be neutral and **not significant.**
Franks Wood and Cranham Brickfields SINC	Small area of permanent irreversible habitat loss (0.48ha representing 6% of the SINC) along the northern edge of the SINC. Habitat creation described in Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.19 is proposed to compensate for this loss. There is also the possible degradation and temporary disturbance of associated species within the site. Good practice mitigation including temporary fencing of retained habitat, dust suppression and surface water runoff treatment as detailed in Section 8.5 would minimise impacts such that the integrity of the county important site and conservation status of the species associated with it would be maintained. The impact would be temporary negligible adverse and would be compensated by the proposed habitat creation outlined in Section 8.5. The subsequent effect would be slight adverse and **not significant**.
Hobbs Hole Wood LWS and ASNW	Permanent irreversible habitat loss associated with the proposed works in the vicinity of junction 29 of the M25, affecting the western edge of the grassland within the county-valued LWS (0.35ha representing 13% of the LWS), although outside the area of ancient woodland. Habitats impacted would primarily comprise ruderal and semi-natural woodland edge. Woodland planting described in Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.19 is proposed to compensate for this loss. Habitat degradation due to possible pollution events and disturbance to species, could occur within the site. Good practice mitigation including temporary fencing of retained habitat, dust suppression and surface water runoff treatment as detailed in Section 8.5 would minimise impacts, such that the integrity of the site and conservation status of the species associated with it would be maintained. This would result in permanent minor adverse impacts and effects that are considered to be slight adverse and **not significant**. A greater level of impact is not predicted since the extent and magnitude of the impact would not be sufficient to adversely affect the overall integrity and key characteristics of the

Designated site	Impacts, mitigation and overall likely effects
	biodiversity resource within the site. Furthermore, the nationally important ancient woodland would be retained.
Pot Kiln Wood and Sickle Wood SINC	None – the SINC is located 117m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the site from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this SINC of county-level importance would be neutral and **not significant**.
Codham Hall Wood LWS and ASNW	Permanent irreversible habitat loss associated with the proposed works in the vicinity of junction 29 of the M25, affecting the western edge of the site. Loss of ancient woodland (0.24ha representing 3% of the LWS), degradation and disturbance to associated species within the site. Ancient woodland compensatory planting across an area of 26ha at Hole Farm, described in Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.19 is proposed to compensate, in part, for this loss. Although the Project would require the removal of only a small amount of habitat from within the designated site, given the ancient status of this woodland, any habitat lost is considered to be irreplaceable. Good practice mitigation including temporary fencing of retained habitat, dust suppression and surface water runoff treatment as detailed in Section 8.5 would reduce the likely impacts such that the conservation status of the species associated with the designated site would be maintained. The loss of ancient woodland, which is of national importance, would be a minor permanent adverse level of impact. A greater level of impact is not predicted since the extent and magnitude of the impact would not be sufficient to adversely affect the overall integrity and key characteristics of the biodiversity resource within the site. A permanent minor adverse impact would result in an effect that is moderate adverse and **significant**.
Ancient woodland west of M25 junction 29 and Codham Hall Wood West SINC	Permanent irreversible habitat loss associated with the proposed works in the vicinity of junction 29 of the M25, affecting the eastern edge of the site. Loss of ancient woodland (0.15ha representing 6% of the site), degradation and disturbance to associated species within the site. Ancient woodland compensatory planting across an area of 4.8ha immediately west of this site is described in Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.19 and is proposed to compensate, in part, for this loss. Given the ancient status of the woodland and its national importance, any habitat lost is considered to be irreplaceable. Good practice mitigation including temporary fencing of retained habitat, dust suppression and surface water runoff treatment as detailed in Section 8.5 would reduce the likely impacts. Given the extent of the predicted habitat losses, it is likely that the impact would not adversely affect the integrity of the site and therefore a permanent minor adverse impact would occur, which would result in a moderate adverse effect that is **significant**.
Hillview SINC	None – the SINC is located 105m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the site from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this SINC, which is of national importance, would be neutral and **not significant**.

Designated site	Impacts, mitigation and overall likely effects
Jackson's Wood/ Tylers Shaw LWS and ASNW	None – the LWS/ASNW is located 21m away from the Order Limits. Good practice mitigation including temporary fencing of retained habitat, dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the site from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this nationally important LWS would be neutral and **not significant**.
Tomkyns East Pastures SINC	None – the SINC is located 166m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the site from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this SINC, which is of county importance, would be neutral and **not significant**.
Tylers Common SINC	None – the SINC is located 274m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the site from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this SINC, which is of county importance, would be neutral and **not significant**.
Folkes Lane Wood ASNW	No direct habitat loss as the site is 2m from the Order Limits but potential for habitat degradation due to possible pollution events. Good practice mitigation including temporary fencing, dust suppression and surface water runoff treatment as detailed in Section 8.5 would avoid this and ensure the integrity and conservation status of the nationally important site would be maintained. There would be no change to this site, and the effects of the construction phase would therefore be neutral and **not significant**.
Coombe Wood LWS (including Foxburrow Wood LWS and Coombegreen Wood ASNW)	None – no construction works are proposed within the LWS or ASNW which are immediately adjacent to the Order Limits. Construction in this area is limited to habitat creation, with large areas of both woodland planting and grassland creation. This will connect Coombe Wood LWS with the surrounding woodland, (refer to (Figure 2.4: Environmental Masterplan (Application Document 6.2)). Habitat degradation due to possible pollution events. Good practice mitigation including temporary fencing of retained habitat, dust suppression and surface water runoff treatment as detailed in Section 8.5 would avoid this and ensure the integrity and conservation status of the site, which is of county importance, would be maintained. There would be no change to this site, and the effects are considered to be neutral and **not significant.**
Jermains Wood SINC	No habitat loss as the site is not within the Order Limits. Habitat degradation due to possible pollution events. Good practice mitigation including temporary fencing of retained habitat, dust suppression and surface water runoff treatment as detailed in Section 8.5 would avoid this and ensure the integrity and conservation status of the site, which is of county importance, would be maintained. There would be no change to this site, and the effects are considered to be neutral and **not significant.**
Tylers Hall Pond SINC	None – the SINC is located 441m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the site from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this SINC, which is of county importance, would be neutral and **not significant**.

Designated site	Impacts, mitigation and overall likely effects
Ingrebourne Valley SINC	None – no construction works are proposed within the SINC which is located 286m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the woodland from likely indirect effects during construction. There would be no change to the site, and the effect of the Project on this LWS would therefore be neutral and **not significant**.
Cat's Mede LWS and Sheepfold Wood ASNW	No habitat loss as the site is not within the Order Limits. Habitat degradation due to possible pollution events. Good practice mitigation including temporary fencing of retained habitat, dust suppression and surface water runoff treatment as detailed in Section 8.5 would avoid this and ensure the integrity and conservation status of the site, which is of county importance, would be maintained. There would be no change to this site, and the effects are considered to be neutral and **not significant.**
Parker's Shaw LWS	None – no construction works are proposed within the LWS which is immediately adjacent to the Order Limits. Construction in this area is limited to habitat creation, with large areas of both woodland planting and grassland creation. This will connect Parkers Shaw LWS with the surrounding woodland, (refer to (Figure 2.4: Environmental Masterplan (Application Document 6.2)). Good practice mitigation identified in Section 8.5 including temporary fencing of important habitats, dust suppression measures, safeguarding the Root Protection Areas of retained trees and surface water runoff treatment would safeguard the LWS from likely indirect effects during construction. There would be no change to this site, and the effects are considered to be neutral and **not significant.** This effect would eventually become slight beneficial in the long term, with the establishment of the new woodland planting.
Holden's Wood LWS	None – the LWS is located 385m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the site from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this LWS, which is of county importance, would be neutral and **not significant**.
Warley Place LWS	None – the LWS is located 345m from the Order Limits. Good practice mitigation including dust suppression and surface water runoff treatment as detailed in Section 8.5 would safeguard the site from likely indirect effects during construction. There would be no change to this site, and the effect of the Project on this LWS, which is of county importance, would be neutral and **not significant**.
The Wilderness ASNW	Habitat loss (0.44ha representing 100% of the ASNW at this site) due to the new A122 Lower Thames Crossing alignment conflicting with the southern section of the woodland. Given its status as ancient woodland, this habitat is considered to be irreplaceable. Habitat degradation due to possible pollution events and disturbance to badgers, bats and nesting birds present would be mitigated by the good practice mitigation identified in Section 8.5. This mitigation would include temporary fencing of retained habitats, translocation of protected species to suitable retained habitats and newly created receptor sites that can accommodate such species, and nesting bird checks carried out by an Ecological Clerk of Works. This mitigation would reduce the likely impacts such that the conservation status of the species associated with the designated site would be maintained.

Designated site	Impacts, mitigation and overall likely effects
	Compensatory woodland planting would be provided to compensate, in part, for the loss of this habitat. Ancient woodland compensation planting totalling 32ha is proposed north of the River Thames, focused principally on a 30ha area of planting at Hole Farm and Folkes Farm, either side of the M25 just north of junction 29 (see ES Figure 2.4: Environmental Masterplan Section 14 (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.19, S14.13). However, the loss of ancient woodland, which is assessed to be of national importance, would be a permanent major adverse level of impact that would adversely affect the integrity of the site. This would result in an effect that is large adverse and significant.

Table 8.34 Non-statutory designated habitats north of the River Thames – air quality impact summary

Designated site	Importance	Level of impact	Effect
AW_Theme_ID1420009 AW	National	Negligible adverse	Slight adverse **Not significant**
AW_Theme_ID1420010 AW	National	Negligible adverse	Slight adverse **Not significant**
AW_Theme_ID1495743 AW	National	Negligible adverse	Slight adverse **Not significant**
Low Well Wood (AW_Theme_ID 1505468) AW	National	Negligible adverse	Slight adverse **Not significant**
Mill Wood (AW_Theme_ID 1119931) AW	National	Negligible adverse	Slight adverse **Not significant**
Round Shaw (AW_Theme_ID 1119930) AW	National	Negligible adverse	Slight adverse **Not significant**
Arena Essex, West Thurrock LWS	County	Negligible adverse	Neutral **Not significant**
Arisdale Avenue LWS	County	No change	Neutral **Not significant**
Brickbarn Wood and Coombe Wood, South Ockendon LWS	County	Negligible adverse	Neutral **Not significant**
Low Well Wood, South Ockendon LWS	County	Negligible adverse	Slight adverse **Not significant**
Mardyke LWS	County	Negligible adverse	Neutral **Not significant**
Thick/Hollow Bottom Shaws LWS	County	Negligible adverse	Neutral **Not significant**
Tilbury Marshes LWS	County	No change	Neutral **Not significant**

Designated site	Importance	Level of impact	Effect
Codham Hall Wood West SINC	County	Negligible adverse	Slight adverse **Not significant**
Cranham Hall Shaws and Pasture SINC	County	Negligible adverse	Neutral **Not significant**
Puddle Dock Angling Centre SINC	County	No change	Neutral **Not significant**

Plants and habitats

8.6.262 The likely effects on habitats associated with the construction phase would be:

a. Habitat loss

b. Habitat degradation

8.6.263 **Habitat loss**: The construction phase of the Project would result in habitat losses and gains of both a temporary and permanent nature. Permanent gains are classified as habitat created in the National Highways landscape planting (or land owned by National Highways) and where habitat has been reinstated or created to compensate for the predicted losses. Table 8.35 shows all the habitat losses and gains associated with the Project. The losses and gains associated with habitats that are considered to be of local importance or higher are then further discussed (see paragraphs 8.6.264 to 8.6.288).

Table 8.35 Habitat losses and gains associated with the Project to the north of the River Thames

Existing habitat	Importance	Habitat loss	New semi-natural habitat (from EMP)	Habitat permanent gain	Net permanent gain (gain – loss)
Ancient woodland	National	2.01ha	Ancient woodland mitigation planting (LE8.2)	32ha	29.9ha (Not considered a net gain due to the irreplaceable nature of the habitat lost)
Ancient and veteran trees	National	Three veteran trees lost. No loss of ancient trees. See Figure 8.2 (Application Document 6.2) for locations.	Scattered Trees (LE2.7)	0.13ha	0.13ha
Semi-natural broadleaved and mixed woodland	County	9.9ha	Native Woodland (LE2.1), woodland with non-native species (LE2.11), wet/carr woodland (LE2.14), woodland edge (LE2.2), scrub woodland (LE2.22), linear belts of shrubs and trees (LE2.4)	173.73ha	98.91ha
Plantation woodland	Local	64.92ha			
Scrub	Local	24.03ha	Scrub (LE2.8), shrubs with intermittent trees (LE2.5)	45.88ha	21.85ha
Scattered and parkland trees	Local	Not calculated, see Figure 8.2 (Application Document 6.2) for locations.	See scattered trees (LE2.7) above	–	–
Acid grassland	County	1.14ha	Translocated acid grassland (LE8.6)	5.03ha	3.89ha

Existing habitat	Importance	Habitat loss	New semi-natural habitat (from EMP)	Habitat permanent gain	Net permanent gain (gain – loss)
Neutral grassland	County	60.48ha	Species-rich grassland (LE1.3),	221.18ha	160.7ha
Improved grassland	Local	41.83ha	Reinstated only	15.86ha	-25.97ha
Marshy grassland	Local	0.05ha	Wet grassland (LE6.4)	35.11ha	35.06ha
Species-poor semi-improved grassland	Local	68.35ha	Reinstated only	36.63ha	-31.72ha
Tall ruderal	Local	11.54ha	Reinstated only	5.89ha	-5.65ha
Non-ruderal herbs	No appreciable importance	0.04ha	Reinstated only	0.04ha	0ha
Swamp	County (BAP habitat)	0.68ha	Wetland/fenland creation (LE8.4)	0.14ha	-1.07ha
	Local	0.53ha			
Standing water (ponds)	County	1.86ha	Water bodies – standing water (LE6.11) and ecology pond (LE8.5)	23.79ha	20.89ha
Standing water (reservoirs and lakes)	Local	1.04ha			
Coastal	County	0.40ha	Reinstated only	0.40ha	0ha
Arable	Local	1,037.17ha	Reinstated only	497.61ha	-539.56ha
Amenity grassland	No appreciable importance	11.82ha	Reinstated only	8.50ha	-3.32ha
Ephemeral/short perennial	Local	4.50ha	Green roof (LE7.2)	0.23ha	-4.27ha
Open mosaic habitats	National	66.91ha	Open mosaic (LE8.1)	199.75ha	132.84ha

Existing habitat	**Importance**	**Habitat loss**	**New semi-natural habitat (from EMP)**	**Habitat permanent gain**	**Net permanent gain (gain – loss)**
Coastal and Floodplain Grazing Marsh	National	0ha	Marsh and wet grassland – coastal grazing marsh (LE6.41)	31.08ha	31.08ha
Other habitats	No appreciable importance	155.37ha	Reinstated only	218.25ha	62.88ha
Existing linear habitats	Importance	Habitat loss length (km)	New habitat (from EMP)	Habitat permanent gain (km)	Net permanent gain (km) (gain – loss)
Hedgerow – native species-rich	County	8.82km	Native species hedgerow untrimmed (LE4.3) and native hedgerow with trees (LE4.4)	50.59km	13.12km
Defunct hedgerow – native species-rich		2.96km			
Hedgerow – native species-rich with trees		4.17km			
Hedgerow – native species-poor	Local	14.9km			
Defunct hedgerow – native species-poor		4.49km			
Hedgerow – native species-poor with trees		2.13km			

Existing habitat	Importance	Habitat loss	New semi-natural habitat (from EMP)	Habitat permanent gain	Net permanent gain (gain – loss)
Hedgerow – non-native species	No appreciable importance	0.10km	Reinstated only	0.08km	-0.02km
Standing water (ditches)	Local	19.59km	Banks and ditches (LE6.2)	41.08km	21.49km
Running water (rivers and streams)	County	2.88km	Reinstated only	3.54km	0.66km

Ancient woodland

8.6.264 The Project would result in the irreversible loss of 2.01ha of nationally important ancient woodland to the north of the River Thames. To compensate for the loss of this woodland, 32ha of woodland planting (see (Application Document 7.5) Clause no. LSP.19) would be created. The full extent of habitat loss and assessment of impacts as a result of the Project on areas of ancient woodland within the study area are considered in detail in the designated sites section, above (refer to Table 8.33 . See Figure 8.33 (Application Document 6.2) for locations of ancient woodland impacts and compensation areas.

Ancient and veteran trees

8.6.265 Of the ancient and veteran trees to the north of the River Thames, three are to be permanently removed (T362, T363 and T570). The trees to be removed are veteran trees and no ancient trees are likely to be adversely impacted. Further details regarding this assessment are provided in Appendix 7.12: Arboricultural Impact Assessment (Application Document 6.3). Implementation of the measures as detailed in Chapter 7: Landscape and Visual (Sections 7.5 and 7.6) would compensate, in part, for the loss of these trees through the planting of additional trees, retaining suitable dead wood material within the retained areas of ancient woodland and habitat creation areas within the Order Limits (to provide habitat features for other receptors such as terrestrial invertebrates) (see CoCP (Application Document 6.3, ES Appendix 2.2), REAC Ref. TB018, LV031, LV032) and targeted veteranisation pruning during construction of suitable retained trees within the Order Limits. However, ancient and veteran trees are nationally important, and lost trees are considered irreplaceable. Given only a small number of veteran trees would be lost, the overall integrity of the veteran tree resource within the ZoI would be maintained, and the diversity of species and levels of species populations which ancient and veteran trees support within the ZoI would likely be sustained following their removal. Therefore, a permanent minor adverse impact would occur, resulting in a moderate adverse effect that is **significant**.

Woodland and scrub

8.6.266 Construction works would result in the permanent irreversible removal of 9.9ha of semi-natural broadleaved and mixed woodland that is of county importance, and the permanent loss of 64.92ha of plantation woodland and 24.03ha of scrub habitat that is of local importance. To compensate for the loss of non-ancient woodland and scrub, 173.73ha of new woodland planting and 45.88ha of scrub planting is proposed to the north of the River Thames (see Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.19). In addition to this, landscape planting as outlined in Figure 2.4: Environmental Masterplan (Application Document 6.2) will contribute to additional woodland habitat creation. Following the proposed habitat creation, a temporary negligible adverse level of impact on the county-level important woodland resource and local level scrub resource would persist, eventually becoming slight beneficial with the establishment of the new woodland and scrub planting. The overall effects would be slight adverse and **not significant**.

Grassland

8.6.267 The Project would result in the irreversible loss of 1.14ha of unimproved and semi-improved acid grassland located within Low Street Pit LWS, Mucking Heath LWS and Blackshots Nature Reserve LWS, and which is of county importance. To compensate for this loss, 5.03ha of acid grassland habitat would be created within close proximity to the existing grassland. This would be achieved through soil translocations and targeted management to encourage the establishment of acidic species (see Figure 2.4: Environmental Masterplan (Application Document 6.2), the Design Principles (Application Document 7.5) Clause no. LSP.22, PRO.04, PLA.05, LSP.02, LSP.04 and LSP.09, and REAC Ref. TB019). The level of impact on acid grassland as a result of the Project would be permanent minor adverse, resulting in a slight adverse effect which is considered **not significant**.

8.6.268 The Project would also result in the irreversible loss of 60.48ha of semi-improved neutral grassland of county importance. To compensate for this grassland loss, 221.18ha of species-rich neutral grassland will be created within mitigation areas and also within areas of landscape planting as outlined in Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.22, PRO.04, PLA.05, LSP.02, LSP.04 and LSP.09. Following the creation of this compensatory habitat, this would result in a permanent minor adverse level of impact and the overall effects would be slight adverse and **not significant**.

8.6.269 Additional losses of improved grassland (41.83ha), marshy grassland (0.05ha) and species-poor semi-improved grassland (68.35ha) would also occur as a result of the Project. Following construction, 15.86ha of improved grassland and 36.63ha of species-poor semi-improved grassland would be reinstated. The residual losses of these habitats would be compensated, together with the loss of 0.05ha of marshy grassland, by the creation of 35.11ha of wet grassland as well as the creation of species-rich grassland, as described above in paragraphs 8.6.267 and 8.6.268. Following the creation of this compensatory habitat, this would result in an irreversible permanent minor adverse level of impact on the locally important habitats and the overall effects would be slight adverse and **not significant**.

Swamp and marginal vegetation

8.6.270 The majority of the swamp and marginal vegetation habitat present within the ZoI, some of which is of county importance, will be retained as part of the Project, with only a small irreversible loss of 1.21ha occurring. To compensate for this, 0.14ha of wetland/fenland will be reinstated, as well as the wet grassland will be planted within mitigation areas as outlined in Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. S9.13. The creation of this compensatory habitat would result in a permanent minor adverse impact and the overall effects would be slight adverse and **not significant**.

Running water

8.6.271 The route alignment of the Project would cross the Mardyke and Golden Bridge Sewer. The Project design provides for two separate viaducts: one viaduct over the Mardyke watercourse and another viaduct over the Golden Bridge Sewer. No direct impact to the Mardyke is anticipated.

8.6.272 Culvert creation along 46m of the Tilbury Main would involve works within the river including dewatering and excavation of the riverbed resulting in temporary habitat loss. The loss of riverbed would be compensated for by the creation of online ditch habitat in the vicinity of Coalhouse Fort (see Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. S9.13). The level of the likely impacts from the culvert would be irreversible permanent minor adverse, resulting in a slight adverse effect which is **not significant**.

8.6.273 The stream within Thames Chase is already culverted under the M25 where the stream crosses the Order Limits. The slight widening of the M25 in this location would result in little effect on this watercourse and as such, a neutral level of impact is anticipated. The effects are considered to be no change and **not significant**.

Standing water

8.6.274 Construction works would result in the irreversible loss of 31 ponds of county importance, within five of which GCN presence has been confirmed. As described in Section 8.5, the loss of non-GCN ponds would be compensated through the creation of new ponds at a ratio of 1:1 as part of the landscape design (Figure 2.4: Environmental Masterplan (Application Document 6.2)). The loss of five ponds for which GCN are present will be compensated for with the creation of 10 new ponds, as detailed in the amphibians section below. With the implementation of these measures, the level of impact would be permanent minor adverse and the resultant effect would be slight adverse and **not significant**.

8.6.275 Construction of the Project would also result in the loss of 19.59km of ditch habitat to the north of the River Thames. To compensate for these losses, 41.4km of ditch habitat would be created, as shown in Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. S9.13. This would therefore compensate the predicted habitat loss and provide a net gain in wetland habitat. The level of impact on locally important ditch habitats would therefore be temporary negligible adverse, resulting in effects that are neutral and **not significant**.

Hedgerows

8.6.276 The Project would result in the loss of 15.95km of hedgerow habitat that is of county importance, and 21.52km of hedgerow habitat that is of local importance. As outlined in Section 8.5, good practice guidance, set out in the Design Principles (Application Document 7.5) Clause no. PRO.04, LSP.13, LSP.14 and LSP.02, would be followed to compensate for these losses by planting 51.32km of new native hedgerows and enhancing existing retained hedgerows within the Order Limits. The implementation of these measures would result in a level of impact that is irreversible permanent minor adverse, resulting in effects that are slight adverse and **not significant**.

Coastal habitats

8.6.277 For an assessment on the impacts on the coastal habitat, please refer to Section 9.6 of Chapter 9: Marine Biodiversity.

Open mosaic habitats

8.6.278 The open mosaic habitat to the west of East Tilbury is located within the Order Limits and is considered to be of national importance. An emergency access route is proposed across the northern section of this field. A small amount of reversible temporary habitat clearance will be required to facilitate this, resulting in a temporary negligible adverse impact. Habitats will be allowed to recolonise the area naturally following construction. Given the small scale and temporary nature of works, the overall effects would be slight adverse and **not significant**.

8.6.279 The other three areas of open mosaic habitat at Baker Street, Low Street Pit LWS and Low Street Pit Station are located within the Order Limits. The construction of the Project would result in the irreversible permanent loss of 66.91ha of this habitat. To compensate for this, 199.75ha of open mosaic habitat creation is proposed across the Project (see Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. S9.13 and LSP.22). This would ensure the ecological function of open mosaic habitat within the ZoI would be sustained, such that the population levels of the species for which it is important, and therefore the overall integrity of the biodiversity resource, would be maintained. Following the creation of the compensatory habitat, this will have a temporary negligible adverse level of impact on open mosaic habitat of national importance and therefore, the overall effects would be slight adverse and **not significant**.

Other habitats

8.6.280 Predicted losses of other habitats, including arable land (1,037.17ha) and ephemeral/short perennial vegetation (4.50ha), which are of local importance, would be compensated through habitat reinstatement (497.61ha of arable land) and the wider proposals of habitat creation (see Figure 2.4: Environmental Masterplan (Application Document 6.2)).

8.6.281 Overall, there would be net gain of approximately 504.53ha of semi-natural habitats of county importance or higher (Table 8.35 in the landscape planting and across the ecological mitigation areas. Over time, this would contribute to enhancing the natural environment, and by establishing coherent ecological networks that are more resilient to current and future pressures. Excluding consideration of the irreplaceable losses of ancient woodland, the proposed habitat creation would result in an overall permanent minor beneficial level of impact and a slight beneficial effect that is **not significant**.

8.6.282 **Habitat degradation**: Temporary indirect impacts associated with dust deposition during the construction phase in dry spells could result in the degradation of retained habitats. As summarised in Section 8.5, this would be avoided by the dust suppression methods set out in the CoCP (Application Document 6.3, ES Appendix 2.2). With the inclusion of the mitigation, the level of impact will be reversible temporary negligible adverse and therefore the overall effects are considered to be neutral and **not significant**.

8.6.283 Temporary indirect impacts associated with dust deposition and pollution during the construction phase could result in the degradation of ancient and veteran trees which are nationally important. As summarised in Section 8.5, mitigation including the installation of solid barriers to protect any retained ancient and veteran trees as set out in Chapter 7: Landscape and Visual (Section 7.5), will be implemented. With the inclusion of the mitigation, the level of impact will be reversible temporary negligible adverse and therefore the overall effects are considered to be slight adverse and **not significant**.

8.6.284 Construction works could result in hydrological drawdown of water bodies or wetter habitats such as marshy grassland and swamp areas, specifically, around the North Portal and the M25 cutting. Design measures set out in Chapter 14: Road Drainage and the Water Environment will avoid the adverse impacts associated with this. With the inclusion of these measures, the level of the impacts is considered to be reversible temporary negligible adverse and the resultant drawdown effects on habitats would be slight adverse and **not significant**.

8.6.285 Construction works within close proximity to ponds and other water bodies could result in degradation through surface water runoff. As summarised in Section 8.5, mitigation measures to control runoff and the discharge of pollutants into water bodies are set out in the CoCP (Application Document 6.3, ES Appendix 2.2). The inclusion of these measures would result in a reversible temporary negligible adverse level of impact that is considered to be slight adverse and **not significant**.

Protected and notable plant species

8.6.286 The likely effects on plant species associated with the construction phase would be:

a. Habitat loss

b. Habitat degradation

8.6.287 **Habitat loss**: there would be direct irreversible habitat loss of terricolous lichen areas due to the construction of the Project. These are of county importance and are located at Low Street Pit LWS and Mucking Heath LWS. The impact would be permanent, although not of a sufficient extent and magnitude to affect the conservation status of the lichens at a county or greater level. The level of impact would be permanent minor adverse. It is proposed that turfs of acid grassland containing terricolous lichens are translocated to the receptor site north of Coalhouse Fort, which is detailed in Figure 2.4: Environmental Masterplan (Application Document 6.2) and REAC Ref. TB019. There would also be direct loss of small numbers of individuals of *Usnea cf. esperantiana* on a blackthorn within the woodland around junction 29 of the M25 and *Physconia distorta* and *Fellhaneropsis vezdae* on ash within the Wilderness Woodland, which are of county value. This would again result in a permanent minor adverse level of impact. It is proposed that the wood on which the lichens reside is translocated to retained habitats within the same woodland where the lichen species are found (REAC Ref. TB020). This would enable the lichen to spread to other trees within these areas. The translocation method for each species will be detailed in the CoCP (Application Document 6.3, Appendix 2.2). The inclusion of this essential and good practice mitigation would maintain the

conservation status of these notable species and result in effects that are considered to be slight adverse and **not significant**.

8.6.288 **Habitat degradation**: Temporary reversible indirect impacts associated with dust deposition during the construction phase in dry spells, could result in the degradation of lichen and bryophyte flora that have a local or site level importance. As summarised in Section 8.5, this would be avoided by the dust suppression methods set out in the CoCP (Application Document 6.3, Appendix 2.2). With the inclusion of the mitigation, the level of impact will be temporary negligible adverse and therefore the overall effects are considered to be neutral and **not significant**.

Terrestrial invertebrates

8.6.289 The likely effects associated with the construction phase on terrestrial invertebrates would be:

a. Habitat loss

b. Direct mortality

c. Disturbance

d. Habitat degradation

8.6.290 **Habitat loss and direct mortality**: Land-take in Survey Areas 3 to 11 and 13, all of which are either of national or county level importance to invertebrates, (see Figure 8.7 (Application Document 6.2)) as a result of the Project would result in loss of foraging, breeding and resting habitat for terrestrial invertebrates, and incidental mortality associated with the habitats being lost through vegetation and ground clearance works. As these two impact pathways are closely associated, they are assessed together.

8.6.291 Where Survey Area 3 (see Figure 8.7 (Application Document 6.2)) coincides with the Project Order Limits, almost all the habitats which supported the invertebrate assemblages recorded there have now been lost as a result of the IVL operations (D.K. Symes Associates, 2017). There are two exceptions: the 12ha mitigation area (which is not included within the Order Limits; and a ditch and associated riparian habitat (approximately 2.0ha in total), that runs north east from the mitigation area (ditch W029N, Appendix 8.4: Freshwater Ecology (Application Document 6.3). This ditch would be lost as a result of the Project. This is considered to represent a minor level of impact as, although not all of the 66 species of notable conservation status and three SATs (‘bare sand & chalk’, ‘scrub-heath & moorland’ and ‘rich flower resource’) of high conservation value recorded within Area 3 would be present within the ditch habitat, it still represents a permanent loss of habitat. However, the larger area of IVL mitigation land (D.K. Symes Associates, 2017 and 2019), would also be retained by the Project.

8.6.292 Survey Area 5, which is a nationally important site for invertebrates, (see Figure 8.7 (Application Document 6.2)) falls within the Tilbury2 development (WYG, 2018). The planning proposal has been granted and the proposals are for the removal of Lytag Brownfield LWS with offsite mitigation at Mucking Flats and Marshes, and the retention of 0.7ha of habitat. As such no impacts on terrestrial invertebrates here are predicted from the Project.

8.6.293 Only small-scale habitat losses would occur in Survey Areas 4 and 6 (Horse Field and Tilbury Marshes LWS) (refer to Table 8.33. It is predicted that the integrity of this nationally important site for invertebrates would be maintained by the Project, with the majority of the habitats retained and safeguarded during the construction phase. This would enable the conservation status and diversity of the invertebrate populations here to be sustained.

8.6.294 In Survey Area 7, which is nationally important, (see Figure 8.7 (Application Document 6.2)), 99% of the Low Street Pit LWS would be permanently lost. This could impact the 36 species of notable conservation status and three SATs ('open short sward', 'scrub-heath & moorland' and 'rich flower resource') of high conservation value. Habitats within the European Metal Recycling section of Survey Area 7 would be temporarily disturbed as a result of proposed utilities works in this area. However, those habitats would be reinstated following construction, and the temporary disturbance of this brownfield site can be beneficial to its long-term value of terrestrial invertebrates, retaining open habitats and preventing succession into predominantly scrub and woodland habitats. Furthermore, the conservation status of the invertebrate assemblages occupying those habitats would be maintained, given many of the species that form the notable assemblage favour brownfield sites that are subject to frequent disturbance.

8.6.295 In Survey Area 8 (see Figure 8.7 (Application Document 6.2)), approximately 46% of the habitats that support a regionally important invertebrate population would be lost to construction of the Project. This would be likely to impact 10 species of recognised conservation status and one SAT ('scrub-heath & moorland') of high conservation value.

8.6.296 In Survey Area 9 (see Figure 8.7 (Application Document 6.2)), approximately 73% of the habitats that support a regionally important invertebrate population would be lost to construction of the Project.

8.6.297 In Survey Areas 10a and 10b (see Figure 8.7 (Application Document 6.2)), approximately 15% of the habitats that support an invertebrate population that is of county level importance would be lost to construction of the Project. This would be likely to impact 16 species of notable conservation status in Survey Area 10a and 13 species of notable conservation status in Survey Area 10b.

8.6.298 In Survey Area 11 (see Figure 8.7 (Application Document 6.2)), approximately 1.5% of the habitats that support an invertebrate population that is of county level importance would be lost to construction of the Project. This would be likely to impact 19 species of notable conservation status and two SATs ('shaded woodland floor' and 'tall sward & scrub') of high conservation value.

8.6.299 In Survey Area 13 (see Figure 8.7 (Application Document 6.2)), approximately 16% of the habitats that support an invertebrate population that is of national importance would be lost to construction of the Project. This would likely impact 48 species of notable conservation status and four SATs ('rich-flower resource', 'scrub edge', 'open short sward' and 'bare sand & chalk') of high conservation value.

8.6.300 Open mosaic habitat lost as part of the vegetation clearance would be compensated at Coalhouse Fort, where areas of open mosaic habitat suitable for terrestrial invertebrates would be created, consisting of wildflower and scrub planting with numerous bunds, bare ground patches and ponds (refer to Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. S9.13 and LSP.22). An extensive area of open mosaic habitat would also be created at Tilbury Fields. Wetland habitat losses would also be compensated for at Coalhouse Fort, where areas of wetland habitat suitable for terrestrial invertebrates would be created, consisting of an extensive ditch network that would be planted with reeds, together with some areas of ponds and wet grassland (see Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. S9.13 and LSP.22). Additional open mosaic and woodland habitat creation at Chadwell St Mary and the M25 mitigation areas would also provide suitable habitat for terrestrial invertebrates. Large areas of grassland habitat with banks and ponds adjacent to the Mardyke would provide habitat suitable for invertebrates and invertebrate assemblages (see the Design Principles (Application Document 7.5) Clause no. PRO.04, LSP.02 and LSP.22).

8.6.301 Loss of habitat due to construction works would take place in advance of habitat creation through mitigation measures, reducing the amount of available invertebrate habitat available for assemblages mentioned above on a temporary basis. This time lag would be further exacerbated by the newly created habitats taking time to mature, create habitat structure diversity and reach a similar quality to habitats lost. However, given the disturbed and ephemeral nature of open mosaic habitats, colonisation would be quick. Considering the proximity of created habitat to habitat lost and the speed at which new habitat can be colonised, the proposed habitat creation would compensate for the losses of terrestrial invertebrate habitats and reduce the residual impact on terrestrial invertebrates to a minor adverse level that would result in a slight adverse effect that is not significant in the medium to long term. A reversible temporary moderate adverse level of impact would persist on a short-term basis (approximately five years) between the time at which habitat clearance is undertaken and the establishment of the newly created habitats. This would result in a moderate adverse effect that is **significant** during that time.

8.6.302 **Disturbance**: Nocturnal species attracted to light (in particular moths, but also other invertebrate species) could suffer temporary disturbance during the construction phase, from artificial lighting used to illuminate construction areas in close proximity to retained habitats. Some compounds will have 24-hour lighting, particularly around the North Portal construction area. This could increase the exposure of invertebrates to predation and reduce the abundance and diversity of the invertebrate assemblages. The light spill from these compounds has been modelled, and would fall to 0.5 lux at a distance of 30m from the compound location (please refer to Appendix 8.15: Construction and Operational Light Spill Calculations (Application Document 6.3).

8.6.303 The inclusion of the mitigation measures in construction phase lighting design would reduce the severity of the impact such that it would be a reversible temporary negligible adverse level of impact that would not affect the

conservation status of the invertebrate assemblages. Therefore, the effect would be slight adverse and **not significant**.

8.6.304 **Habitat degradation**: Habitat degradation due to possible pollution events, dust deposition and accidental drainage of land has the potential to have an adverse impact on invertebrates within retained habitats. However, the inclusion of the embedded Project design and mitigation measures outlined in Section 8.5 to prevent pollution incidents and control surface water runoff would reduce the risk of such incidents and result in a no change level of impact and an effect that is neutral and **not significant**.

Freshwater species

Macro-invertebrates

8.6.305 The likely effects associated with the construction phase on aquatic macro-invertebrates would be:

a. Habitat loss

b. Direct mortality

c. Habitat disturbance

d. Water quality deterioration

e. Habitat degradation

8.6.306 **Habitat loss and direct mortality**: During the construction phase a series of ditches would be permanently and irreversibly lost along stretches of the Project (Appendix 14.4: Hydromorphology Assessment (Application Document 6.3)). The removal of ditches would cause direct mortality and habitat loss to county-level important macro-invertebrates that inhabit them. Ditch habitat creation is proposed in the vicinity of the Mardyke and Coalhouse Fort as embedded mitigation (refer to Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. S9.13 and LSP.22). The inclusion of this embedded mitigation would enable the conservation status and overall diversity of the invertebrate populations here to be sustained, resulting in a temporary negligible adverse level of impact. The resultant effects would be slight adverse and **not significant**.

8.6.307 Culvert installation, most notably on the Tilbury Main, would involve works within that watercourse; dewatering and excavation of the riverbed would result in reversible temporary habitat loss and mortality of macro-invertebrates. There are 10 planned culvert crossings (see Section 2.4 of Chapter 2: Project Description and the Design Principles (Application Document 7.5) Clause no. PRO.04, STR.01, S9.10). The loss of riverbed through the culverting of the Tilbury Main (46m) would be compensated by the creation of online ditch habitat in the vicinity of the Mardyke and Coalhouse Fort (see Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. S9.13 and LSP.22), while the base of the culvert would be sunk below the river level by 150mm to allow natural substrate to form, potentially creating new habitat. The inclusion of this embedded mitigation would result in a temporary negligible adverse level of

impact, and effects that are considered to be slight adverse and **not significant**.

8.6.308 The installation of viaducts over most notably the Mardyke, Golden Bridge Sewer and Orsett Fen Sewer would potentially result in permanent and irreversible localised shading of the watercourses. In total, three viaducts over watercourses are proposed for construction (the remaining being the Tilbury Viaduct over Station Road, the Tilbury Loop Line railway and Coles Reservoir) (see Figure 2.4: Environmental Masterplan (Application Document 6.2) for locations). Light levels within culverts would also be low and would restrict the growth of macrophytes within the affected watercourses. Macro-invertebrates use macrophytes as cover, and the loss of these is likely to reduce habitat for them within the stretches of watercourse being crossed. Online ditch habitat created in the vicinity of the Mardyke and Coalhouse Fort, would compensate for any lost habitat. The inclusion of this embedded mitigation would result in impacts considered to be irreversible permanent minor adverse and effects that are slight adverse and **not significant**.

8.6.309 **Habitat disturbance and habitat degradation and deterioration in water quality**: The mobilisation of ground contaminants resulting in leaching into the local watercourses and increased sedimentation of watercourses caused by large excavations either near or within watercourses, has the potential to affect macro-invertebrate communities through a deterioration of water quality, resulting in mortality of the macro-invertebrate communities. The build-up of sediment has the potential to increase sedimentation of habitats colonised by macro-invertebrates. As summarised in Section 8.5, mitigation measures to control runoff and the discharge of pollutants into watercourses are set out in the CoCP (Application Document 6.3, ES Appendix 2.2). These measures would reduce the risk of pollutants entering watercourses that provide habitat for county-level important macro-invertebrates. The Project would result in no change to the biodiversity resource and likely effects on macro-invertebrates in this area would therefore be neutral and **not significant**.

8.6.310 Temporary reversible impacts associated with dust deposition during the construction phase have the potential to result in indirect habitat degradation through dust settling in watercourses, smothering habitat and resulting in deterioration of water quality caused by contaminants in the dust. This would be avoided by the dust suppression controls set out in the CoCP (Application Document 6.3, ES Appendix 2.2), as summarised in Section 8.5. This would avoid impacts and therefore the effects on macro-invertebrates would be neutral and **not significant**.

Fish

8.6.311 The likely effects to coarse fish and eels during the construction phase would be:

a. Habitat loss

b. Direct mortality

c. Habitat disturbance

d. Habitat degradation

e. Water quality deterioration

f. Habitat fragmentation

8.6.312 **Habitat loss and direct mortality**: The effects of permanent and irreversible habitat loss and direct mortality on fish, which are locally important, and eel, which are regionally important, would be as those outlined above for macro-invertebrates (see paragraphs 8.6.306 to 8.6.308). Therefore, the level of impact on the fish population would be temporary negligible adverse, resulting in effects that are slight adverse and **not significant**.

8.6.313 **Habitat disturbance and habitat degradation and deterioration in water quality**: The effects of habitat disturbance, habitat degradation and water quality deterioration on fish, which are locally important, and eel, which are regionally and nationally important would be as those outlined above for macro-invertebrates (see paragraphs 8.6.309 and 8.6.310). Therefore, the level of impact would be no change, resulting in effects on fish that are neutral and **not significant**.

8.6.314 **Habitat fragmentation**: The permanent and irreversible installation of culverts and the removal of ditches may create barriers to fish migration and therefore result in habitat fragmentation. It is possible that some fish species may avoid passing through culverts due to the light/dark interface caused by the shading of the culvert. This might reduce migration of fish throughout the watercourse, especially on the Tilbury Main culvert. Culverts can also reduce fish passage either by being too shallow, having flows which are too fast for fish to pass, or can be stepped, meaning the fish cannot access the culvert.

8.6.315 The Project uses good practice culvert design as detailed in Chapter 14: Road Drainage and the Water Environment, which would mitigate these issues. The impacts on the locally important fish and regionally important eel populations are considered to be temporary negligible resulting in a slight adverse effect that is **not significant**.

8.6.316 **Noise disturbance**: Noise and vibration from the construction phase of the Project may have a detrimental effect on sensitive fish species during various life stages, potentially resulting in a delay to fish migration through watercourses.

8.6.317 Good practice recommendations as detailed in Chapter 12: Noise and Vibration (Section 12.5) would be implemented to reduce noise and vibration as much as feasible, thus reducing any disturbance to the environment and fish communities in the vicinity of the construction works. Noise disturbance caused by the construction would be temporary while works are undertaken. The impacts on the locally important fish and regionally important eel populations are considered to be reversible temporary negligible adverse resulting in a slight adverse effect that is **not significant**.

Amphibians

8.6.318 The populations of GCN recorded within the study area to the north of the River Thames were assessed as being of county importance for biodiversity. The assemblages of other species of amphibians within the ZoI were assessed as being of no more than local importance and as such have not been assessed

further. Despite this, works would be undertaken in accordance with good practice to safeguard these species, as outlined in Section 8.5.

8.6.319 The likely effects associated with the construction phase on GCN would be:

a. Habitat loss

b. Direct mortality

c. Habitat fragmentation

d. Habitat degradation

8.6.320 **Habitat loss**: The areas of habitat loss for each GCN population are shown on Figure 8.8 (Application Document 6.2) and in Table 8.36 below. In line with discussions with Natural England, permanent irreversible habitat loss constitutes loss under the Project; habitats where the Project would create a barrier making the habitats no longer available to GCN post-construction; and any habitat change through landscaping. Temporary reversible loss constitutes any habitat lost and reinstated as the same habitat. Further details are provided in Appendix 8.17: Draft EPS mitigation licence application – great crested newts (Application Document 6.3).

Table 8.36 Loss of terrestrial habitat within 500m of breeding ponds for each GCN population to the north of the River Thames

GCN population	Habitat loss (ha) within 50m of pond	Habitat loss (ha) within 50m–250m of pond	Habitat loss (ha) within 250m–500m of pond	Suitability of habitats affected
N1	0.83ha	20.78ha	35.12ha	Majority of loss is within arable land and improved grassland that is suboptimal for GCN. However, losses would also occur within semi-improved grassland, woodland, scrub, gardens/allotments and tall herb and fern which are suitable habitat.
N2	5.22ha	38.42ha	66.99ha	Majority of loss is within arable land, improved grassland and amenity grassland that is suboptimal for GCN. However, losses would also occur within semi-improved, marshy and unimproved grassland, woodland, scrub, gardens/allotments, ephemeral/short perennial and tall herb and fern which are suitable habitat.
N3	0ha	2.86ha	2.71ha	Loss of semi-improved grassland and tall herb and fern which are suitable habitat, also loss of arable land, improved and amenity grassland, which are suboptimal for GCN.

GCN population	Habitat loss (ha) within 50m of pond	Habitat loss (ha) within 50m–250m of pond	Habitat loss (ha) within 250m–500m of pond	Suitability of habitats affected
N4	0.23ha	9.44ha	17.61ha	Majority of loss is within arable land, improved and amenity grassland that is suboptimal for GCN. However, losses would also occur within semi-improved grassland, woodland, scrub and tall herb and fern which are suitable habitat.
N5	1.36ha	33.93ha	45.71ha	Majority of loss is within arable land that is suboptimal for GCN. However, losses would also occur within semi-improved grassland, woodland, scrub and tall herb and fern which are suitable habitat.
N6	0.02ha	0.10ha	0.09ha	Loss entirely within arable habitat considered suboptimal for GCN.
N7	1.92ha	7.84ha	15.06ha	Majority of loss is within arable land that is suboptimal for GCN. However, losses would also occur within semi-improved grassland, woodland, scrub and tall herb and fern which are suitable habitat.
N8	0.01ha	0.63ha	1.19ha	Majority of loss is within arable land that is suboptimal for GCN. However, losses would also occur within semi-improved grassland and tall herb and fern which are suitable habitat.
N9	0ha	1.47ha	4.87ha	Majority of loss is within arable land and amenity grassland which are suboptimal for GCN. However, losses would also occur within semi-improved grassland which is suitable habitat.
N10	0ha	8.23ha	13.41ha	Loss of woodland, scrub, semi-improved grassland and tall herb and fern which are suitable habitat, also loss of arable land, improved and amenity grassland, which are suboptimal for GCN.
N11/N12	0.50ha	8.90ha	6.50ha	Majority of loss is within arable land and improved grassland which are suboptimal for GCN. However, losses would also occur within semi-improved grassland, woodland, scrub, wetland and tall herb and fern which is suitable habitat.
N13	0.25ha	8.80ha	9.74ha	Majority of loss is within arable land, improved and amenity grassland which are suboptimal for GCN. However,

GCN population	Habitat loss (ha) within 50m of pond	Habitat loss (ha) within 50m–250m of pond	Habitat loss (ha) within 250m–500m of pond	Suitability of habitats affected
				losses would also occur within semi-improved grassland, woodland and scrub which is suitable habitat.
N14	0ha	2.36ha	13.12ha	Majority of loss is within arable land and improved grassland which are suboptimal for GCN. However, losses would also occur within woodland which is suitable habitat.
N15	0.96ha	2.86ha	0.62ha	Loss of woodland, scrub and semi-improved grassland which are suitable habitat, also loss of improved grassland which is suboptimal for GCN.
N16	0.08ha	12.25ha	17.21ha	Majority of loss is within arable land and amenity grassland which are suboptimal for GCN. However, losses would also occur within woodland, scrub, semi-improved grassland, tall herb and fern and gardens/allotments which are suitable habitat.
Total	**11.38ha**	**158.87ha**	**249.95ha**	

8.6.321 The Project would result in the irreversible loss of five breeding ponds (P230N, P216N, P201N, P406N and P467N) to the north of the River Thames. It would also result in the loss of 420.20ha of terrestrial habitat, of which 94.25ha is within 250m of known breeding ponds. However, most of the habitat loss (70.8%) would be located within habitat considered to be limited value to GCN, namely arable fields. Small amounts of habitat which are of higher value to GCN will also be lost including hedgerows, refuges, woodland and rough grassland which provide foraging, commuting and hibernating opportunities for GCN.

8.6.322 Herpetofauna mitigation areas (as outlined in Section 8.5 and Figure 2.4: Environmental Masterplan (Application Document 6.2)) have been identified throughout the Project within close proximity to known GCN populations. 94.05ha of rough grassland mosaic habitat would be created along with 10 new ponds to compensate for the losses on a 2:1 ratio. In addition, these sites will be landscaped to include south-facing bunds and potential refugia sites. Furthermore, an additional 137.41ha of landscape planting (woodland planting, shrub planting and grassland suitable for GCN) will be created along the highway embankments as outlined in Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. LSP.19, LSP.22, PRO.04, PLA.05, LSP.02, LSP.04 and LSP.09, which would further contribute to the habitat compensation measures. The inclusion of the mitigation measures outlined would sufficiently compensate for the adverse effects associated with habitat loss such that the conservation status of the GCN populations would be maintained. The level of impact would

be reversible temporary negligible adverse on GCN populations of county importance and the resultant effects would be slight adverse and **not significant**.

8.6.323 **Direct mortality**: There would be a potential to encounter GCN within suitable breeding and terrestrial habitats within 500m of a known GCN breeding pond. As such, works within these areas have the potential to injure and/or kill GCN, in the absence of mitigation. The successful implementation, under an appropriate European Protected Species mitigation licence with respect to GCN (Appendix 8.17 (Application Document 6.3)), of the embedded mitigation measures described in Section 8.5 (species translocation, phased vegetation clearance, installing exclusion fencing, site supervision and habitat restoration) would safeguard GCN and prevent the incidental injury or mortality of animals. With the implementation of this mitigation, there would be no adverse impacts on the GCN populations, which are of county importance, and therefore, the overall residual effect of direct mortality would be neutral and **not significant**.

8.6.324 **Habitat fragmentation**: Construction works are not considered to create a permanent barrier to GCN movements between existing breeding ponds in the same metapopulation and valuable terrestrial habitat for foraging or hibernation associated with that metapopulation. Utility works to divert a gas pipe in the vicinity of population N4 would cause a temporary severance of the hedgerow linking P023N to the other ponds within the population. The works are considered to be short term and the hedgerow would be reinstated post-construction (Figure 2.4: Environmental Masterplan (Application Document 6.2)). As the effects of fragmentation are either negligible or small scale and temporary reversible, the level of impact would be temporary negligible adverse and therefore the overall effect on the GCN populations, which are of county importance, would be considered slight adverse and **not significant**.

8.6.325 **Habitat degradation**: Construction works within close proximity to ponds could result in degradation through surface water runoff. As summarised in Section 8.5, mitigation measures to control runoff and the discharge of pollutants into water bodies are set out in the CoCP (Application Document 6.3, ES Appendix 2.2). The inclusion of this mitigation would result in a reversible temporary negligible adverse level of impact and the overall residual effect on the GCN populations, which are of county importance, would therefore be slight adverse and **not significant**.

Reptiles

8.6.326 The likely effects associated with the construction phase on reptiles would be:

a. Habitat loss

b. Direct mortality

c. Habitat fragmentation

8.6.327 **Habitat loss**: The most suitable habitat for reptiles north of the River Thames was associated with LWS and nature reserve areas. Fourteen of the surveyed areas were identified as being ‘key reptile areas’ because of the population size or assemblage present and hence considered to be important for reptiles. The Project would result in the loss, or partial loss of 10 key reptile areas across the

Order Limits to the north of the River Thames, with an additional area also lost, which was not surveyed due to access restrictions (Blackshots Nature Area LWS N27, see Appendix 8.6 (Application Document 6.3)). On a precautionary basis, this area is also considered to be important for reptiles.

8.6.328 The key reptile areas that would be lost were identified as being brownfield, open mosaic, grassland, wetland, scrub and hedgerow habitat.

8.6.329 Nine of the key reptile areas identified during the baseline surveys were situated between the River Thames and the Tilbury Loop railway (within Tilbury Power Station land and Goshems Farm LWS as well as near Low Street Pit). Four of these areas are subject to disturbance from works that are not associated with the Project (the removal of PFA deposits) and so the extent and suitability of the habitat here for reptiles has been substantially reduced since the time of the baseline surveys for the Project.

8.6.330 Other areas of habitat suitable for supporting mostly common and widespread reptile species (namely slow-worm and common lizard) would also be lost across the Project area. These areas include grassland, wetland, scrub, hedgerow and arable field margins. The amount of potentially suitable reptile habitat to be lost is anticipated to be 240.11ha (refer to Table 8.35 .

8.6.331 The permanent and irreversible habitat lost as part of the vegetation clearance would be compensated by the creation of a diverse mosaic of habitat as part of the Project as outlined in Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. S9.13 and LSP.22. Several areas have been identified within the Order Limits for the creation of new habitat designed to connect existing biodiverse areas, which would benefit reptile species. This would comprise areas of open mosaic habitat, wetland and woodland planting. The areas are designed to complement and enhance existing biodiverse areas (around the Thames Estuary) and strengthen others (Mardyke corridor). Features suitable for reptiles would include varied topography, providing slopes and banks for basking, log and brash piles, areas of scrub and flower-rich grassland, providing foraging and hibernation opportunities. The gapping-up of hedgerows post-construction and creation of new hedgerows would also be beneficial for reptiles. The newly created landscape planting would enhance the habitat for a number of species including reptiles, both in terms of shelter and foraging habitat. This would provide a corridor between the M25 in the north-west, the Mardyke, the A13 and the River Thames in the south-east.

8.6.332 The inclusion of the Project design and mitigation measures as detailed above and in Section 8.5 would result in reversible temporary negligible adverse level of impact, and slight adverse effects that are **not significant** to reptile populations north of the River Thames, which are of county importance.

8.6.333 **Direct mortality**: Mainly low populations of common and widespread species of reptile were recorded across the study area to the north of the River Thames. In the absence of mitigation, activities such as vegetation clearance, stockpiling of equipment and material has the potential to harm or kill reptiles. When disturbed, reptiles frequently bury themselves beneath vegetation to evade predation. The latter response to predation makes them particularly vulnerable to being crushed by heavy machinery.

8.6.334 Mitigation measures would include phased and directional habitat clearance, and translocation of reptiles to receptor sites that would be managed and enhanced for reptiles (refer to CoCP (Application Document 6.3, ES Appendix 2.2) and Figure 2.4: Environmental Masterplan (Application Document 6.2)).

8.6.335 The removal of reptiles from the construction footprint and the inclusion of additional mitigation to prevent reptiles re-entering the construction area where necessary, such as the installation of reptile-proof fencing (refer to CoCP (Application Document 6.3, Appendix 2.2) and Figure 2.4: Environmental Masterplan (Application Document 6.2)), would prevent adverse impacts on the reptile populations, which are of county importance, and result in effects that are neutral and **not significant**.

8.6.336 **Habitat fragmentation**: The Project may result in the fragmentation of habitat north of the River Thames. This can be particularly detrimental in marginal areas where suitable habitat is often limited, especially in arable landscapes. Small populations of reptiles are intrinsically at greater risk of localised extinction; further fragmentation is likely to exacerbate this.

8.6.337 Fragmentation is most likely to occur north of the River Thames as the route crosses mainly Green Belt, which is currently used for agricultural (largely arable with some areas of grazing) and recreational purposes.

8.6.338 The impact of fragmentation north of the River Thames would be compensated by the creation of green bridges as detailed in Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. PLA.05, STR.08, STR.04). These would include hedgerow and grassland planting that allow reptiles to move across the Project at Muckingford Road, Hoford Road, Green Lane and North Road.

8.6.339 The Project has been designed to span the Mardyke and Orsett Fen by viaducts, which would allow the free passage of species underneath, hence mitigating any fragmentation effects in that area.

8.6.340 The shading effect of construction of the Project to the north of the River Thames is anticipated to be unlikely to affect the status of reptile populations.

8.6.341 The creation of new grassland and routes for animals to disperse are likely to have a positive impact on populations of reptiles. Suitable habitat is often the limiting factor in arable landscapes. The creation of high-quality habitat is likely to connect existing reptile populations and provide opportunities for expansion. Reptiles are able to rapidly colonise new areas, provided the habitat is suitable (Beebee and Griffiths, 2000).

8.6.342 The successful implementation of mitigation measures would compensate for the predicted adverse impacts of habitat fragmentation and result in overall permanent minor positive level of impacts to reptiles from the opening year of the Project. The resultant effects on reptile populations, which are of county importance, would be a slight beneficial effect that is **not significant**.

Ornithology

8.6.343 The general bird assemblage (primarily associated with farmland and woodland habitats) within the study area north of the River Thames has been assessed as being of county importance. The likely effects on the general bird assemblage

associated with the construction phase to the north of the River Thames would be:

a. Habitat loss

b. Direct mortality

c. Disturbance

8.6.344 **Habitat loss:** All habitat types within the study area to the north of the River Thames have the potential to be used by nesting (both ground-nesting and otherwise), foraging and roosting birds. The full extent of habitat loss is presented in Table 8.35.The temporary reversible or permanent irreversible loss of any habitats would reduce the availability of potential nesting sites and foraging resources for birds throughout the duration of construction. In the short term, this would result in adverse effects, particularly for species that are associated with woodland habitats.

8.6.345 Species nesting nearby within the study area but beyond the Order Limits, may adapt their foraging behaviour and continue to breed as successfully as prior to commencement of construction. Others, such as skylark, may be displaced from breeding territories and may occur in reduced numbers because suitable retained habitat is already well used by breeding pairs.

8.6.346 During construction, retained margins and retained habitats would provide some opportunities for foraging and nesting birds, which would help compensate for the adverse impacts of habitat loss. The loss of mainly arable land and smaller areas of semi-natural habitat during construction would have a temporary adverse impact on breeding and non-breeding birds at site or local level. However, it is unlikely that such impacts would adversely affect the local conservation status of bird assemblages.

8.6.347 Short-eared owl and marsh harrier have been recorded foraging within the study area north of the River Thames, between Tilbury Power Station and Coalhouse Fort. Habitats that are likely to provide a valuable foraging resource for these species in this area include unimproved and semi-improved grassland and swamp. The full extent of losses of these habitats is presented in Table 8.35.The temporary or permanent loss of these habitats would reduce the availability of foraging resources for short-eared owl and marsh harrier during the construction phase.

8.6.348 Implementation of the Project design and mitigation measures (habitat creation) described in Section 8.5 and shown on Figure 2.4: Environmental Masterplan (Application Document 6.2) would compensate the adverse effects of habitat loss over time as newly created habitats establish and become suitable for use by birds, including short-eared owl and marsh harrier. The habitat creation proposals would provide a much more extensive and more diverse mosaic of semi-natural habitats within the Order Limits, providing benefits of additional foraging and nesting opportunities compared to the largely agricultural habitats lost, with a net gain predicted in the medium to long term for higher value habitats such as woodland and hedgerows. To further compensate the loss of nesting opportunities while newly created habitats establish, the habitat creation measures would be supplemented by the provision of bird nest boxes within areas of retained woodland and trees.

8.6.349 The overall level of impact from habitat loss would be reversible temporary negligible adverse, not being of a sufficient extent or magnitude to be likely to affect the conservation status of the general bird assemblage to the north of the River Thames, which is of regional level importance. This would result in effects that are slight adverse and **not significant**.

8.6.350 **Direct mortality:** Nesting birds (the adult birds, nests, eggs and dependent young) are vulnerable to works occurring in close proximity that might damage or destroy a nest site during breeding (March to August inclusive). Implementation of the embedded and good practice mitigation measures (fencing, timing of vegetation removal and supervision of works) described in Section 8.5 and the REAC (part of Appendix 2.2 (Application Document 6.3), REAC Ref. TB004) would avoid such impacts and would provide protection for birds and their nests throughout the construction phase. The resultant effects would therefore be neutral and **not significant** on nesting birds north of the River Thames, which are of regional importance.

8.6.351 Some low-flying bird species (e.g. thrushes and game birds) are especially vulnerable to collision with vehicles, particularly where site-traffic routes are near to features such as woodland edges and hedgerows. Implementation of the embedded and good practice mitigation measures described in Section 8.5 detailed within the CoCP (Application Document 6.3, ES Appendix 2.2), including fencing of the construction area and adherence to standard low speed limits for construction vehicles would reduce the risk of mortality of birds through collision. The level of impact would be reversible temporary negligible adverse and would result in effects that are considered to be slight adverse and **not significant** on the general bird assemblage north of the River Thames, which is of regional importance.

8.6.352 The Project includes the construction of alternative pylon routes to allow for the construction of the Project. One OHL alignment located adjacent to the Tilbury Railway is shifting 150m from the exiting alignment, and another OHL located adjacent to the A13 is shifting 220m. The location of these new alignments is away from the River Thames, where the largest aggregation of birds are to be found. This, in addition to the presence of the existing OHL and multiple other exiting OHL, would lead to a level of impact which would be irreversible permanent minor adverse and would result in effects that are considered to be slight adverse and **not significant** on the general bird assemblage north of the River Thames, which is of regional level importance.

8.6.353 **Disturbance:** Nesting birds are also vulnerable to disturbance from changes in noise, lighting and vibration. Those birds listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) are afforded legal protection from disturbance while breeding. The embedded and good practice mitigation measures listed in Section 8.5, including the careful timing of vegetation removal to avoid nesting birds (see REAC (part of Appendix 2.2 (Application Document 6.3)), REAC Ref. TB004), would avoid the risk of disturbance being caused to specially protected species that could be nesting within retained habitats. Furthermore, where potentially disturbing construction activities would commence during the bird breeding season in close proximity to retained habitats that could support specially protected nesting birds, the ECoW would first monitor those retained habitats and advise on any additional measures that

may be required to avoid disturbance, such as the use of screening or acoustic fencing, if the presence of specially protected species is confirmed.

8.6.354 It is considered that the location of the North Portal is sufficiently distant (in excess of 400m) from habitat that is functionally linked to the Thames Estuary and Marshes SPA and Ramsar site (or otherwise of ornithological importance) that any noise and vibrations caused by its construction or the boring operations are unlikely to result in any measurable adverse effects on birds.

8.6.355 It is feasible that the use of Fort Road as a construction access route could cause disturbance to birds using Tilbury Fort, which was found to support a significant nocturnal roost of dunlin and other wading birds associated with the Thames Estuary and Marshes SPA and Ramsar site. However, this road is already subject to high levels of background disturbance, from being used as a construction access route for the Ingrebourne Valley project at Goshems Farm and Tilbury Power Station. It is unlikely that any likely increases in noise and visual disturbance associated with site traffic for the Project using Ford Road would result in elevated levels of disturbance that would adversely affect the conservation status of the bird populations using Tilbury Fort. This is further assessed in Chapter 12: Noise and Vibration and the Habitats Regulations Assessment – Screening Report and Statement to Inform an Appropriate Assessment (Application Document 6.5).

8.6.356 Implementation of the embedded mitigation measures described in Section 8.5, including the use of screening where necessary to safeguard any particularly sensitive areas such as the Thames Estuary and Marshes SPA and Ramsar site, would reduce the impact of disturbance. It is likely that disturbance of birds would be a reversible temporary negligible adverse level of impact that would not affect the conservation status of the bird populations concerned, which are of regional importance. Therefore, the effect would be slight adverse and **not significant**. Further details regarding the assessment of birds associated with the Thames Estuary and Marshes SPA and Ramsar site are provided in Appendix 8.7 (Application Document 6.3).

Barn owl

8.6.357 The likely effects associated with the construction phase on barn owls to the north of the River Thames, which are of county importance, would be:

a. Habitat loss

b. Disturbance

c. Fragmentation

8.6.358 **Habitat loss**: The following habitat types are valuable as foraging habitat for barn owls and would incur losses as a result of the Project (see Table 8.35 for quantification of habitat losses and gains):

a. Acid grassland

b. Neutral grassland

c. Marshy grassland

d. Species-poor semi-improved grassland

e. Improved grassland

f. Swamp

8.6.359 Implementation of the Project design (Figure 2.4: Environmental Masterplan (Application Document 6.2) and Design Principles (Application Document 7.5) Clause no. PRO.04, LSP.22, S12.02, S12.06, S12.10, S12.11, S12.12) and mitigation measures described in Section 8.5, including the creation of species-rich grassland, open mosaic habitats, wetland and hedgerows would compensate for the predicted habitat losses and provide additional foraging resources for barn owls as habitats establish and mature over time. Furthermore, these habitats would quickly establish once created, so that within approximately two to five years after creation they would provide suitable foraging resources for barn owls. The impact of habitat loss on barn owls would be reversible temporary negligible adverse, resulting in effects that are considered to be slight adverse and **not significant** on barn owls north of the River Thames.

8.6.360 Three barn owl breeding sites would be lost as a direct result of the construction phase, due to their proximity to construction works. The provision of alternative breeding sites would therefore be required as compensation for these losses. This would be achieved by the erection of new barn owl nest boxes at a ratio of two new nest boxes to every one breeding site lost, and will be a minimum of 1.5km away from the Project and other major roads, within an appropriate setting (according to specifications given by Shawyer, 2011) (see the CoCP (Application Document 6.3, ES Appendix 2.2) (REAC Ref. TB010). With such compensatory measures in place, it is likely that the impact on the county barn owl population from the loss of these breeding sites would be reversible temporary negligible adverse. The provision of the alternative nesting sites would mean that the population, which is of county-level importance, could be sustained and as such the effect on barn owls would be slight adverse and **not significant**.

8.6.361 **Disturbance:** All ten breeding sites would be vulnerable to disturbance as a result of nearby construction works. This includes the three nests being lost as a direct result of the construction works, as nests will be vulnerable to disturbance until they are removed. The likelihood and severity of the disturbance risk would vary, depending on the type and proximity of construction works and the presence of pre-existing ‘screening’ (natural or built structures which would reduce the effect of disturbing activities, e.g. dense woodland could reduce visual, noise and light disturbance).

8.6.362 Where a breeding site is not effectively screened by pre-existing structures, additional measures would be required to prevent disturbance during the breeding season . This would include monitoring of potential nest sites prior to and during construction works by a suitably qualified ECoW. It could also potentially include the deliberate closure of nesting sites prior to the commencement of works, to prevent birds from breeding in areas that are likely to be subject to unavoidable disturbance. It is possible that the impact of disturbance on barn owl would result in three additional nest sites being lost. The provision of new barn owl nest boxes at a ratio of two new nest boxes for every one breeding site lost, a minimum of 1.5km away from the Project and other major roads, within an appropriate setting (according to specifications

given by Shawyer, 2011), is considered sufficient compensation to address any such additional disturbance impacts (see the CoCP (Application Document 6.3, ES Appendix 2.2) (REAC Ref. TB010)). With such compensatory measures in place, it is likely that the impact on the barn owl population from the loss of these breeding sites would be reversible temporary negligible adverse. The provision of the alternative nesting sites would mean that the population, which is of county-level importance, could be sustained and as such the effect on barn owls would be slight adverse and **not significant**.

8.6.363 **Fragmentation**: The construction of the Project would result in the fragmentation of habitats to the north of the river. This would be compensated by the provision of four green bridges to the north of the River Thames and the viaducts over the Mardyke and Golden Bridge Sewer, and the Orsett Fen Sewer (Figure 2.4: Environmental Masterplan (Application Document 6.2) and Design Principles (Application Document 7.5, PLA.05, STR.08, STR.04)). As such, the likely impact of fragmentation on barn owl within the ZoI to the north of the River Thames, which are of county importance, would be irreversible permanent minor adverse and result in effects that are considered to be slight adverse and **not significant**.

Bats

8.6.364 The assemblage of bat species within the ZoI to the north of the River Thames has been assessed as being of county importance.

8.6.365 The likely effects of construction on bats would be:

a. Habitat loss

b. Disturbance

c. Habitat fragmentation

d. Direct mortality

8.6.366 **Habitat loss:** The construction of the Project would result in the permanent irreversible loss of foraging and commuting habitat of limited value for bats, predominantly consisting of arable (1,037.17ha), semi-improved neutral grassland (60.48ha ha), species-poor semi-improved grassland (68.35ha), improved grassland (41.83ha) and amenity grassland (11.82ha).

8.6.367 Woodland habitat north of the River Thames is also being lost with the loss of 2.1ha of ancient woodland, 9.9ha of semi-natural broadleaved and mixed woodland, 64.92ha of plantation woodland and 24.03ha ha of scrub. This habitat is of particular use to the woodland bat species which are the rarest group of bats recorded onsite. Areas of woodland surveyed such as the Wilderness Woodland (classified as having a moderate value to bats) would lose approximately half of its woodland habitat still only recorded relatively low levels of bat activity averaging just 1.5 passes per night on automated static detectors within the woodland (Transect 22).

8.6.368 Generally, activity was highest at transects that were relatively close to large water bodies (Transect 14, 18, 19 and 20).The majority of these habitats fall

outside the Order Limits and are therefore retained, with only 1.04ha of standing water (reservoirs and lakes) being lost.

8.6.369 The loss of this habitat would be compensated by habitat creation. Large areas of woodland planting are proposed to compensate for the loss of woodland, with particular areas located around Rainbow Shaw, Thames Chase and Hole Farm. Additionally, there will be large area of open mosaic and wetland habitats created, which will provide additional foraging areas for bats. The largest of these areas are at Coalhouse Fort and along the Mardyke.

8.6.370 Five of the eleven confirmed roosts and four of the six likely roosts identified within the study area would be lost during the construction phase. All roosts are considered to be of local value. The five confirmed roosts to be lost were found to support a widespread and common species (The Rosery had a peak count of four common pipistrelle and one possible soprano pipistrelle; Estate House, 1 Bridge Cottage and 2 Grays Corner all had a peak count of one common pipistrelle; and Yellowstock had a confirmed peak count of one common pipistrelle with two potentially emerging on another night). Of the four likely roosts, three were tree roosts that were potentially in use by widespread and common species, noctule that are widespread but in small numbers in the county; and potentially a myotis species that would be rare regardless of species. However, Daubenton's are known to be widespread and relatively frequent near water (Tree 116 possible single noctule, Tree 183 peak count of a possible noctule and myotis on one survey and two common pipistrelle on another survey, Tree 185 possible single unknown bat emergence and Alde Cottage peak count of two common pipistrelle likely emerged).

8.6.371 In addition to these known roosts, the habitat losses associated with woodlands and trees would be likely to result in the permanent and irreversible loss of features that are potentially suitable for supporting tree-roosting bats. This would equate to the loss of approximately 63 high suitability and 104 moderate suitability trees. The loss of these features would be compensated, as outlined in Section 8.5 and the REAC (part of Appendix 2.2 (Application Document 6.3), REAC Ref. TB009), through the provision of artificial bat roosts within retained areas of woodlands and trees.

8.6.372 The removal of these roosts would be undertaken under a European Protected Species mitigation licence with respect to bats from Natural England (Appendix 8.16 (Application Document 6.3)), and the mitigation measures would be implemented prior to their removal. This proposal would maintain the favourable conservation status of the bat populations.

8.6.373 Overall, impacts of habitat loss on the bat assemblage, which is of county importance, would be compensated by the proposed mitigation and compensation measures such that the level of impact would be reversible temporary negligible adverse in the short to medium term, resulting in effects that would be slight adverse and **not significant.**

8.6.374 **Disturbance:** Activities resulting in increased levels of noise, vibration or light can lead to bats abandoning roosts as well as severing flightlines and abandoning foraging habitat as they seek to avoid the disturbance. Although some bat species can become habituated to a degree of disturbance, this is less likely to happen if the disturbance begins when bats are already present.

Bats are particularly susceptible to disturbance impacts during the sensitive hibernation and maternity periods.

8.6.375 Seven confirmed roosts (Manor Farmhouse (55m from construction works), Manor Farm Barn (74m from construction works), Benton Farmyard (Barn) (616m from construction works), Benton Farmyard (Workshop) (625m from construction works), St Mary Magdalene Church (41m from temporary utilities works and over 250m from the main construction works), Tree 1003 (198m from construction works), Tree 1036 (160m from construction works)) within the study area would be retained. Manor Farmhouse, Manor Farm Barn, Benton Farmyard (Barn) and Benton Farmyard (Workshop) are identified as confirmed brown long-eared bat roosts (feeding perches, night roosts or non-breeding day roosts) assessed to be of local value. St Mary Magdalene Church is a SINC partly due to a bat roost of an unknown species or type of roost. Tree 1003 is a noctule maternity roost of county value and Tree 1036 contained likely noctule droppings so is being considered a noctule roost of local value. Tree 1015 is considered a probable bat roost.

8.6.376 The construction of the Project would not have a detrimental impact on either roost at Benton Farm owing to the distance from the Project (over 600m). Tree 1003 and Tree 1015 are situated within woodland blocks in a golf course with separate woodland blocks surrounding it, and Tree 1036 is similar as it is 160m away and has a woodland block separating this roost from the construction works. Both the distance from construction works and the extensive tree coverage surrounding Tree 1003, Tree 1015 and Tree 1036 would reduce any disturbance to the roosts, with noise modelling indicating a minor increase in noise levels during the construction phase.

8.6.377 St Mary Magdalene Church is located approximately 350m away from the M25, so will already be habituated to disturbance from traffic activities. Noise modelling has shown a negligible increase in noise levels at this roost.

8.6.378 Noise modelling for the roosts within Manor Farm show a potential moderate increase in noise levels overnight. The noise modelling also shows that in the daytime there will a negligible increase in noise levels, with a minor increase being shown in the evening. These impacts will be mitigated by the erection of bat boxes in the vicinity of these roosts.

8.6.379 Working measures detailed in Section 8.5 would reduce any disturbance impacts as a result of construction activity, including the lighting design, with modelling stating a predicted lux value of between 0.5–1 lux for areas adjacent to known bat roosts (please refer to Appendix 8.15: Construction and Operational Light Spill Calculations (Application Document 6.3). With the mitigation set out in the CoCP (Application Document 6.3, ES Appendix 2.2), possible disturbance impacts on the bat assemblage, which is of county importance, would be reversible temporary negligible adverse and result in effects that are slight adverse and **not significant**.

8.6.380 **Habitat fragmentation**: The construction of the Project would result in the severing of bat territories at a number of locations, potentially reducing foraging habitat available to individual bats.

8.6.381 Activity surveys identified four key crossing locations: Tilbury Loop (Transect 13 surveys), Hoford Lane (Crossing Point 6 and Transect 14 surveys), Green Lane

(Crossing Point 8 surveys) and the unnamed hedgerow between the Mardyke and a reservoir in the vicinity of Fen Lane (Crossing Point 9 and Transect 19 surveys). All these locations are relatively close to large water bodies (Green Lane is the furthest from a large water body with the nearest section of tree line being approximately 700m from Grangewaters), which provide good quality foraging habitat.

8.6.382 To mitigate the impacts of fragmentation, four mixed use green bridges would be created to maintain bat commuting routes. These green bridges are designed to allow bats to cross over the Project at Muckingford Road, Hoford Road, Green Lane and North Road (see Section 8.5 for more details). Additionally, the Project is on a viaduct at both the Tilbury Loop line, over the Mardyke and Golden Bridge Sewer and the Orsett Fen Sewer. These viaducts will allow free movement of bats under the Project. The landscape planting has been designed to guide bats to these crossing points.

8.6.383 With the short term impact from the delay of the establishment of the green bridges and construction of the viaducts, the habitat fragmentation impact on bat assemblages of county importance would be reversible temporary negligible adverse, and result in effects that are slight adverse and **not significant**.

8.6.384 **Direct mortality**: There are 63 high suitability trees and 104 trees moderately suitable for bat roosting within the Order Limits that would be lost as a result of the works. Although they were not identified to be supporting roosting bats (refer to Appendix 8.8 (Application Document 6.3)), the suitability remains during the construction phase and loss of the trees. As detailed in Section 8.5, Appendix 8.16: Draft EPS mitigation licence application – bats (Application Document 6.3) and the REAC (part of Appendix 2.2 (Application Document 6.3), REAC Ref. TB015), pre-construction surveys and inspections immediately prior to any felling works are proposed to mitigate the risk of killing or injuring bats.

8.6.385 Bat mortality due to direct contact with site vehicles is unlikely due to the low speed of site vehicles and the limited amount of 24-hour construction activities. As such, the risk of mortality would be mitigated and the likely effects on the county-level important bat assemblage within the Zol to the north of the River Thames would be reversible temporary negligible adverse, and would result in effects that are neutral adverse and **not significant**.

Water voles

8.6.386 The likely effects of construction would be:

a. Habitat loss

b. Direct mortality

c. Disturbance

d. Habitat fragmentation

e. Habitat degradation

8.6.387 **Habitat loss**: The construction of the Project would result in the permanent irreversible loss of 2,038m of confirmed linear water vole habitat, and the temporary loss of another 942m of confirmed linear water vole habitat. The largest area of habitat loss occurs within the watercourses immediately adjacent

to the northern shore of the River Thames, with some additional areas lost in the vicinity of Linford and the Mardyke. Where feasible, watercourses have been retained in the design as important water vole features (see Figure 2.4: Environmental Masterplan (Application Document 6.2)). The wetland habitat creation included in Figure 2.4: Environmental Masterplan (Application Document 6.2) as described in Section 8.5 and the Design Principles (Application Document 7.5) Clause no. S9.13, close to the Mardyke, would include the creation of approximately 3km of ditch habitat, and 1.5ha of wetland habitat including reedbeds, and would therefore compensate the predicted habitat loss and provide a net gain in suitable water vole habitat.

8.6.388 Within the Mardyke area, there would be some temporary reversible habitat loss due to construction of two viaducts: one over the Orsett Fen Sewer and another over the Mardyke and Golden Bridge Sewer. These construction areas would be reinstated as optimum water vole habitat once the structures have been constructed. Furthermore, close to the Mardyke, watercourses would be enhanced to become more suitable for water vole by a mink eradication programme as included in the CoCP (Application Document 6.3, ES Appendix 2.2) and described in Section 8.5, to increase the water vole population close to the Mardyke. In addition, there would be some culverting and diversion of watercourses between the Mardyke and Ockendon Landfill site; however, these are only seasonally wet ditches and are of limited value to water vole.

8.6.389 The habitat creation as detailed in Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. S12.06 would ensure that any temporary and permanent losses of water vole habitat would be compensated, with an overall net gain in suitable habitat being provided.

8.6.390 The overall level of impact of habitat loss on the water vole populations, which are regionally important, would therefore be reversible temporary negligible adverse and result in effects that would be slight adverse and **not significant**.

8.6.391 **Direct mortality**: The construction of the Project may result in the direct mortality of water voles, by removal of watercourses, bankside vegetation clearance, and construction works where water voles may be present in burrows. Suitable working practices of pre-construction surveys, fencing-off retained habitats and translocating water vole from construction areas associated with watercourses have been detailed in the Section 8.5 and ES Appendix 8.20: Draft water vole conservation licence application (Application Document 6.3). These would be implemented within these areas to prevent injury or mortality to water voles during construction. Translocations will move water vole to an offsite location in partnership with the EWT (see Consents and Agreements Position Statement (Application Document 3.3)). These animals will be part of an ongoing programme to reintroduce water vole to parts of Essex that have suffered from localised extinctions.

8.6.392 Impacts on the water vole populations, which are regionally important, from direct mortality would be avoided through the mitigation referenced above. The effects on water vole would therefore be neutral and **not significant**.

8.6.393 **Disturbance**: Water vole presence has been confirmed within and adjacent to the Order Limits and disturbance is likely to occur during the construction

phase. The potential for disturbance effects is most notable within the watercourses adjacent to the River Thames, although this area is already subject to a high degree of background disturbance. Working measures including fencing-off retained watercourses as detailed within the CoCP (Application Document 6.3, Appendix 2.2), as described in Section 8.5, would reduce the magnitude and extent of the likely disturbance impacts on water vole territories. Where water vole are found to be present, measures to avoid disturbance would be incorporated into a Natural England conservation licence (Application Document 6.3, Appendix 8.20). With suitable mitigation measures in place, any disturbance impacts would be temporary and unlikely to affect the conservation status of the water vole populations.

8.6.394 The overall level of impact of disturbance on the water vole populations, which are regionally important, would be reversible temporary negligible adverse and result in effects that would be slight adverse and **not significant**.

8.6.395 **Habitat fragmentation**: The watercourses adjacent to the River Thames are considered as key commuting and dispersing routes for the water vole population in this area. A large proportion of watercourses here would remain unaffected by the Project. One watercourse (W021 – Tilbury Main), would however be culverted under the route alignment, with another three watercourses removed (W029, W030 and part of W020) (see Figure 8.27 (Application Document 6.2)). These construction activities would lead to a restriction in the ability of water vole to commute within this area while construction is taking place. It is considered that this would be a temporary effect and surveys have shown the population either side of these watercourses is self-sustaining. As such, this temporary habitat fragmentation would not cause any long-term isolation effects that could affect the conservation status of the water vole population. The permanent culvert structure would be a 46m long oversized box culvert design with an integrated mammal ledge included. For full details see Section 8.5. There is limited evidence regarding the maximum length of culvert used by water vole before they present a significant barrier to movement. The Water Vole Conservation Handbook (Strachan *et al.*, 2011) states that '*culverting does not seem to provide a major problem to water vole movement or fragmentation*', although it also states that *'length may present a problem to water vole daily movement and dispersal*'.

8.6.396 Due to the length of the culvert, and the lack of existing evidence of water vole using culverts of the proposed length, it is considered that this habitat fragmentation could have an irreversible permanent minor adverse level of impact on the water vole populations, which are regionally important, and result in a slight adverse effect that is **not significant**.

8.6.397 Temporary works to the Mardyke would create a temporary obstruction to water vole commuting and dispersing from populations to the north and south of the Project. This obstruction would be present for between one and two years during the construction phase. Within the vicinity of the Mardyke, watercourses would be enhanced to become more suitable for water vole by a mink eradication programme as included in the CoCP (Application Document 6.3, Appendix 2.2) and described in Section 8.5, to increase the water vole population in the vicinity of the Mardyke. In agreement with the landowner, this mink eradication programme would extend an additional 2km downstream of the Project Order Limits to increase the benefits the programme would provide.

With these measures implemented and considering the small-scale and temporary nature of the fragmentation impact, it is not envisaged that this would provide a considerable obstacle for commuting and dispersing water voles such that the conservation status of the population could be impacted.

8.6.398 The overall level of impact on the water vole populations, which are regionally important, would therefore be reversible temporary negligible adverse and result in slight adverse effects that would be **not significant**.

8.6.399 **Habitat degradation**: Accidental pollution events during construction may cause long-term impacts to water vole habitats. This may result in habitat degradation, particularly if such events reduced the extent and diversity of the aquatic vegetation that water vole rely upon, and which requires good water quality. Water pollution prevention measures as detailed in the CoCP (Application Document 6.3, Appendix 2.2) and described in Section 8.5 would avoid any such pollution impacts associated with the construction phase. The effect on water vole populations, which are regionally important, would therefore be neutral and **not significant**.

Otters

8.6.400 The population of otters within the ZoI to the north of the River Thames is considered to be of county importance.

8.6.401 The likely effects of construction would be:

a. Habitat loss

b. Direct mortality

c. Disturbance

d. Habitat fragmentation

e. Habitat degradation

8.6.402 **Habitat loss**: The construction of the Project would result in the permanent loss of 2,430m of suitable linear otter habitat, and the temporary loss of another 500m of suitable linear otter habitat. The largest area of habitat loss occurs within the watercourses immediately adjacent to the northern shore of the River Thames, with some additional areas lost in the vicinity of Linford and the Mardyke. Where feasible, watercourses would be retained as important otter features. The wetland habitat creation included in Figure 2.4: Environmental Masterplan (Application Document 6.2), as described in Section 8.5 and the Design Principles (Application Document 7.5) Clause no. S9.13, in the vicinity of the Mardyke would include the creation of 3km of ditch habitat, and 1.5ha of wetland habitat, and would therefore compensate for the predicted habitat loss and provide a net gain in suitable otter habitat. In addition, the Project will be creating a further 4.3km of open channel watercourses to divert existing channels. These watercourses will be created to be suitable for otter once the habitat has established.

8.6.403 Within the Mardyke area, there would be some temporary habitat loss due to construction of the viaduct over the Orsett Fen Sewer and another viaduct over

the Mardyke and Orsett Fen Sewer. These construction areas would be reinstated as optimum otter habitat once the structures have been constructed. In addition, there would be some culverting and diversion of watercourses between the Mardyke and Ockendon Landfill site; however, these are only seasonally wet ditches and are of limited value to otter.

8.6.404 The habitat creation as detailed in Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5). Clause no. S9.13 would ensure that any temporary and permanent losses of otter habitat would be compensated, with an overall net gain in suitable habitat being provided.

8.6.405 The impacts on the otter populations, which are of county importance, would therefore be reversible temporary negligible adverse and result in effects that would be slight adverse and **not significant**.

8.6.406 **Direct mortality**: The construction of the Project would involve activities that may, in the absence of mitigation, result in the direct mortality of otter, including works associated with the removal of watercourses and bankside vegetation. Suitable working practices including pre-construction surveys and fencing-off retained habitat have been detailed in Section 8.5 which would be implemented to prevent injury or mortality of otters during construction.

8.6.407 The level of impact on the otter populations, which are of county importance, would therefore be no change and result in effects that would be neutral and **not significant**.

8.6.408 **Disturbance**: Two potential otter lying-up sites were identified within 100m of the proposed crossing of the Mardyke. Neither of these locations contained any evidence to suggest their occupation by otter. Working measures, including pre-construction surveys and fencing-off retained habitat, as outlined in Section 8.5 would reduce the likely disturbance effects of any nearby otter resting sites and holts. If otter were found to be present, measures to avoid disturbance would be incorporated into a Natural England Protected Species licence.

8.6.409 With suitable mitigation measures in place, the level of impact of disturbance would be reversible temporary negligible adverse and result in effects on the otter populations, which are of county importance, that would be slight adverse and **not significant**.

8.6.410 **Habitat fragmentation**: The watercourses adjacent to the River Thames are considered as a potential commuting route for otter recolonisation north of the River Thames. A large proportion of watercourses here would remain unaffected by the Project. One watercourse (W021 – Tilbury Main), would however be culverted under the route alignment, with another three watercourses removed (W029, W030 and part of W020) (Figure 8.27 (Application Document 6.2)). These construction activities would lead to a restriction in the ability of otter to commute within this area while construction is taking place. It is considered that this would be a temporary effect during construction, and that the current use of this area by otter is limited. As such, this temporary habitat fragmentation would not cause any long-term isolation effects that could affect the conservation status of the otter population. The permanent culvert structure would be a 46m long oversized box culvert design with an integrated mammal ledge included. Otter are known to use these culverts on a regular basis, so this is not envisioned to be a restriction for otter.

8.6.411 The temporary obstruction of the Mardyke during the construction phase would be present for between one and two years. Within this area all access roads would be speed limited to 15mph. The area is of a rural character with no major roads present within this area. It is therefore not envisaged that this would pose a considerable obstacle to commuting and dispersing otter.

8.6.412 An existing culvert under the M25 will be removed and replaced with a new structure. The existing structure lacks any provision for commuting of otter during flood situations. The new box culvert will be 46m in length and will include a mammal ledge to allow otter to commute in flood conditions. The construction of the new culvert will last between one and two years and will prevent otter commuting along this watercourse on a temporary basis.

8.6.413 Overall, the level of impacts associated with habitat fragmentation on the otter populations, which are of county importance, would be reversible temporary negligible adverse and result in effects that would be slight adverse and **not significant**.

8.6.414 **Habitat degradation**: Accidental pollution events during construction may cause long-term impacts to otter habitats. This may result in habitat degradation, particularly if such events reduced the extent and diversity of the aquatic species that otter rely upon, and which require good water quality. Pollution prevention measures as detailed in the CoCP (Application Document 6.3, ES Appendix 2.2) and described in Section 8.5 would avoid any such pollution impacts associated with the construction phase. The impact on the otter populations, which are of county importance, would be no change and the effect would therefore be neutral and **not significant.**

Badgers

8.6.415 Badger have been assessed as being of local importance within the ZoI to the north of the River Thames.

8.6.416 The likely effects of construction on badger would be:

a. Habitat loss

b. Direct mortality and disturbance

c. Habitat fragmentation

8.6.417 **Habitat loss**: North of the River Thames a total of three main setts would be lost as a result of construction activities. One main sett has a suitable alternative badger sett already existing within the social group's territory. The remaining two main setts would have artificial setts created prior to construction to compensate their loss (see the REAC (part of Appendix 2.2 (Application Document 6.3), REAC Ref. TB008).

8.6.418 As well as these main setts a total of 13 subsidiary setts, two annex setts and 29 outlier setts currently occupied by badgers will be closed under licence. All badger sett closures would be undertaken under a Natural England development licence (Application Document 6.3, Appendix 8.19).

8.6.419 In addition to the loss of these setts, some areas of foraging habitat would be lost due to the construction of the Project. The successful implementation of the

Project design and mitigation measures described in Section 8.5, including habitat creation and strengthening and improving hedgerows, would result in greater connectivity and better-quality habitats for badger.

8.6.420 The level of impact of habitat loss on badger, which are locally important, would therefore be reversible temporary negligible adverse and result in effects that would be slight adverse and **not significant**.

8.6.421 **Direct mortality and disturbance**: Construction activities may result in the disturbance or direct mortality of badger located within setts. To avoid this, suitable working methodologies would be employed to ensure that any works within close proximity to any retained setts, or any setts being closed under licence, would avoid any direct mortality of badgers (as detailed in Appendix 8.19: Draft badger development licence application (confidential) (Application Document 6.3). Any retained setts would be monitored to ensure that disturbance does not affect the use of the sett (see the CoCP (Application Document 6.3, ES Appendix 2.2)). The level of impact on badger, which are locally important, would therefore be reversible temporary negligible adverse and result in effects that would be slight adverse and **not significant**.

8.6.422 **Habitat fragmentation**: The construction of the Project would result in fragmentation of habitat to the north of the River Thames. The provision of four green bridges would ensure that commuting routes are available that allow badger to move within the wider landscape. In addition to the green bridges, where the route alignment is on a viaduct or overbridge then the free movement of badger would be provided for under the Project as shown in Figure 2.4: Environmental Masterplan (Application Document 6.2) and described in detail in Section 8.5.

8.6.423 As such, any fragmentation impacts on badger, which are locally important, would be irreversible permanent minor adverse and result in effects that would be slight adverse and **not significant**.

Nitrogen Deposition Compensation Sites

8.6.424 The likely effects of habitat creation within the nitrogen deposition compensation sites during construction on ecological receptors include the following:

a. Habitat loss – direct loss of habitat as a result of construction

b. Direct mortality – construction activities causing direct mortality

c. Fragmentation – preventing animals dispersing and moving within the wider landscape

d. Habitat degradation – causing the habitat to become suboptimal, e.g. through pollution events, etc.

e. Disturbance – noise and visual disturbance of species present, including from anthropomorphic influences

Plants and habitats

8.6.425 The likely effects on habitats associated with the construction phase would be:

a. Habitat loss

b. Habitat degradation

8.6.426 **Habitat loss**: Habitat creation within the nitrogen deposition compensation sites would result in the permanent and irreversible loss of arable habitat, the retention and, where relevant, improved management of neutral grassland, field margins, trees, hedgerows and ditches, and the permanent creation and long-term management of lowland mixed deciduous woodland and lowland meadow. The proportion of newly created habitats would be approximately 70% to 30% lowland mixed deciduous woodland and lowland meadow respectively, with the objective of creating a mosaic of wildlife-rich habitats (see the oLEMP) (Application Document 6.7)).

8.6.427 Overall, there would be net gain of approximately 200ha of semi-natural habitats across the nitrogen deposition compensation sites. The location of these sites is designed to provide an overall increase in wildlife-rich semi-natural habitat which create new, and strengthen existing links within the wider network of designated sites. This would contribute to enhancing the biodiversity value of the area, and would establish coherent ecological networks which would be more resilient to current and future pressures such as climate change. The proposed habitat creation would result, in the long-term, in a permanent addition to and improvement of the network of semi-natural habitats of county importance and would therefore constitute a permanent major beneficial impact and a moderate beneficial effect that is **significant**.

8.6.428 **Habitat degradation**: Temporary indirect impacts associated with dust deposition and pollution during the construction phase in dry spells could result in the degradation of retained habitats. As summarised in Section 8.5, this would be avoided by the dust suppression methods set out in the CoCP (Application Document 6.3, Appendix 2.2). With the inclusion of the mitigation, the level of impact will be reversible temporary negligible adverse and therefore the overall effects are considered to be neutral and **not significant**.

8.6.429 Construction works within close proximity to ponds and other water bodies could result in degradation through surface water runoff. As summarised in Section 8.5, mitigation measures to control runoff and the discharge of pollutants into water bodies are set out in the CoCP (Application Document 6.3, Appendix 2.2). The inclusion of these measures would result in a temporary negligible adverse level of impact, and an effect that is considered to be neutral and **not significant**.

Amphibians

8.6.430 The population of GCN recorded within the nitrogen deposition compensation sites, specifically at area Maol3_D2 Court Wood, south of the River Thames was assessed as being of county importance for biodiversity.

8.6.431 The likely effects associated with the construction phase on GCN would be:

a. Habitat loss

b. Direct mortality

c. Habitat fragmentation

d. Habitat degradation

8.6.432 **Habitat loss**: The permanent and irreversible conversion of arable habitats within the nitrogen deposition compensation sites to semi-natural habitats would benefit the GCN population at Pond 9 in Nitrogen Deposition area MaoI3_D2 Court Wood, south of the River Thames. Arable land represents low value habitat for foraging and shelter for GCN, whereas areas of broadleaved woodland and grassland meadow, particularly where these occur in a mosaic pattern, are of greater value, offering opportunities for shelter and supporting a range of invertebrate prey species. Pond 9 is less than 50m from Nitrogen Deposition area MaoI3_D2 Court Wood, south of the River Thames which is core foraging habitat. As such, the level of impact on the GCN population, which is of county importance, would be a permanent major beneficial level of impact and a slight beneficial effect that is **not significant**.

8.6.433 **Direct mortality**: There would be a potential to encounter GCN within suitable habitats within 500m of a known GCN breeding pond. As such, works within these areas have the potential to injure and/or kill GCN, in the absence of mitigation. The approach to habitat creation would be to encourage natural regeneration, combined with tree planting and sowing areas of grassland. This would be undertaken in daylight hours with small-scale plant and workforce and would be supervised by an ECoW (see the CoCP (Application Document 6.3, Appendix 2.2) (REAC Ref. TB006)). The habitat affected by this work provides limited cover and foraging opportunity for GCN. Taken together, this risk of mortality to GCN as a result of habitat creation within this area is considered reversible temporary negligible adverse, and therefore, the overall residual effect of direct mortality would be neutral and **not significant**.

8.6.434 **Habitat fragmentation**: The location of habitat creation works adjacent to Pond 9 would not result in a barrier to GCN movements between existing breeding ponds in the same metapopulation, or valuable terrestrial habitat for foraging or hibernation associated with that metapopulation. The potential impact from fragmentation are considered reversible temporary negligible adverse, the overall residual effect would be considered neutral and **not significant**.

8.6.435 **Habitat degradation**: Construction works within close proximity to ponds could result in degradation through surface water runoff. As summarised in Section 8.5, mitigation measures to control runoff and the discharge of pollutants into water bodies are set out in the CoCP (Application Document 6.3, ES Appendix 2.2). The inclusion of this mitigation would result in a temporary negligible adverse level of impact and the overall residual effect on the GCN populations, which are of county importance, and therefore the overall residual would be neutral and **not significant**.

Badger

8.6.436 The badger sett recorded at area MAoI1_A Hole Farm East has been assessed as being of local importance within the nitrogen deposition compensation sites.

8.6.437 The likely effects of construction on badger would be:

a. Habitat loss

b. Direct mortality and disturbance

c. Habitat fragmentation

8.6.438 **Habitat loss**: No setts would be lost as a result of the habitat creation works. The conversion of arable land to semi-natural habitats would benefit badgers by increasing the extent and diversity of high value foraging habitat. As such, the level of impact on the badger population, which is of local importance, would be a permanent minor beneficial level of impact and a slight beneficial effect that is **not significant**.

8.6.439 **Direct mortality and disturbance**: Construction activities have the potential to result in disturbance or direct mortality of badgers located within setts. No setts are being removed as part of the habitat creation. Suitable working methodologies would be employed to ensure that any plant activity within close proximity of retained setts, would avoid any direct mortality of badgers (as detailed in Appendix 8.19: Draft badger development licence application (confidential) (Application Document 6.3). All retained setts would be monitored to ensure that disturbance does not affect the use of the sett (see the CoCP (Application Document 6.3, ES Appendix 2.2), REAC Ref. TB002, TB006, TB014). The level of impact on badger, which are locally important, would therefore be reversible temporary negligible adverse and result in effects that would be slight adverse and **not significant**.

8.6.440 **Habitat fragmentation**: The approach to habitat creation would be to encourage natural regeneration, combined with tree planting and sowing areas of grassland. There would be no requirement for open excavations. This would be undertaken in daylight hours with small-scale plant and workforce and would be supervised by an ECoW (see the CoCP (Application Document 6.3, ES Appendix 2.2) (REAC Ref. TB006)). These works are not considered to create a permanent barrier to badger movements between setts and foraging areas during habitat creation works. The level of impact would be reversible temporary negligible adverse and therefore the overall effect on the badger population, which is of local importance, would be considered slight adverse and **not significant**.

Operational phase

South of the River Thames

8.6.441 The likely effects of operation on ecological receptors include the following:

a. Direct mortality – operation of the Project causing direct mortality

b. Fragmentation – preventing animals dispersing and moving within the wider landscape

c. Habitat degradation – causing the habitat to become suboptimal, for example through changes in air quality, specifically nitrogen deposition, and pollution events

d. Disturbance – noise and visual disturbance of species present, including from anthropomorphic influences

Statutory and non-statutory designated sites

8.6.442 The likely effects of operation of the Project on statutory and non-statutory designated sites would be habitat degradation (direct and indirect including air quality and pollution events, especially where sites are hydrologically linked to the Order Limits.

8.6.443 **Habitat degradation**: No direct impacts are anticipated on any statutory designated sites during the operation of the Project. In the absence of mitigation, effects from habitat degradation could however occur.

8.6.444 There is potential for effects associated with increased nitrogen deposition on designated habitats within close proximity to the new carriageway and the ARN from traffic emissions (see Sections 5.4 and 5.5 of Chapter 5: Air Quality. Appendix 8.14: Designated Sites Air Quality Assessment (Application Document 6.3), considers the effects of nitrogen deposition on designated sites which require further consideration in line with DMRB LA 105 Air Quality (Highways England, 2020b). A summary table of the conclusions of Appendix 8.14 (Application Document 6.3) is presented in Table 8.37 below. Where sites are affected by both construction and operational increases in nitrogen deposition, these are identified, and the assessment takes into account the cumulative durational effect of sites experiencing increased nitrogen deposition during both the construction and operational phase of the Project.

Table 8.37 Designated habitats south of the River Thames – air quality impact summary

Designated site (AW – ancient woodland. VT – veteran tree)	Importance	Level of impact	Effect
Andrews Wood (AW_Theme_ID 1499246) AW	National	Moderate adverse	Moderate adverse **Significant**
AW_Theme_ID_1486679 (Object ID 9096) AW	National	Major adverse	Large adverse **Significant**
AW_Theme_ID_1486820 (A2/M2 ROUNDABOUT) AW	National	Major adverse	Large adverse **Significant**
AW_Theme_ID_1486860 (Shorne Woods) AW	National	Major adverse	Large adverse **Significant**
AW_Theme_ID_1486867 (Head Barn Wood) AW	National	Major adverse	Very large adverse **Significant**
AW_Theme_ID_1486883 (Object ID 9151) AW	National	Moderate adverse	Moderate adverse **Significant**
AW_Theme_ID_1486891 (Between M2 carriageways) AW	National	Major adverse	Large adverse **Significant**
AW_Theme_ID_1486937 (Longhoes) AW	National	Moderate adverse	Moderate adverse **Significant**
AW_Theme_ID_1498304 AW	National	Negligible adverse	Slight adverse **Not significant**

Designated site (AW – ancient woodland. VT – veteran tree)	Importance	Level of impact	Effect
AW_Theme_ID_1498718 AW	National	Major adverse	Very large adverse **Significant**
AW_Theme_ID1486951 AW	National	Minor adverse	Moderate adverse **Significant**
AW_Theme_ID1493831 AW	National	Negligible adverse	Slight adverse **Not significant**
AW_Theme_ID1494010 AW	National	Moderate adverse	Moderate adverse **Significant**
AW_Theme_ID1499144 AW	National	Moderate adverse	Moderate adverse **Significant**
AW_Theme_ID1499145 AW	National	Moderate adverse	Moderate adverse **Significant**
AW_Theme_ID1499250 AW	National	Negligible adverse	Slight adverse **Not significant**
Bridge Woods AW	National	Major adverse	Large adverse **Significant**
Claylane Wood AW	National	Negligible adverse	Slight adverse **Not significant**
Coneyearth/Pascalls/Hollows Woods (AW_Theme_ID 1499437) AW	National	Negligible adverse	Slight adverse **Not significant**
Dane Shaw (AW_Theme_ID 1498350) AW	National	Negligible adverse	Slight adverse **Not significant**
Frith/Impton Woods AW	National	Minor adverse	Slight adverse **Not significant**
Great Crabbles Wood AW	National	Negligible adverse	Slight adverse **Not significant**
Great Wood AW	National	Major adverse	Large adverse **Significant**
Impton/Podkin Wood AW	National	Negligible adverse	Slight adverse **Not significant**
Merrals Shaw (AW_Theme_ID 1486881) AW	National	Moderate adverse	Large adverse **Significant**
Milstead/Bassilne Wood (AW_Theme_ID 1498502) AW	National	Negligible adverse	Slight adverse **Not significant**
Mintching/Kingsdown Wood AW	National	Negligible adverse	Slight adverse **Not significant**
Peartree Wood AW (construction and operational impacts)	National	Moderate adverse	Moderate adverse **Significant**

Designated site (AW – ancient woodland. VT – veteran tree)	Importance	Level of impact	Effect
Putt Wood AW	National	Negligible adverse	Slight adverse **Not significant**
Reed's Shaw (AW_Theme_ID 1498441) AW	National	Moderate adverse	Moderate adverse **Significant**
Shorne/Brewers Woods AW (construction and operational impacts)	National	Major adverse	Large adverse **Significant**
Upper Brooms Wood AW ((AW_Theme_ID_1498405 (Object ID 11581))	National	Negligible adverse	Slight adverse **Not significant**
Westerham Wood (AW_Theme_ID 1499087) AW	National	Negligible adverse	Slight adverse **Not significant**
Yaugher Wood (AW_Theme_ID 1498451) AW	National	Negligible adverse	Slight adverse **Not significant**
Rede Common LNR	County	Moderate adverse	Slight adverse **Not significant**
Blue Bell Hill Banks And Verges LWS	County	Moderate adverse	Slight adverse **Not significant**
Bridge Woods, Burham LWS	County	Major adverse	Moderate adverse **Significant**
Court Wood, Shorne LWS (construction and operational impacts)	County	Moderate adverse	Slight adverse **Not significant**
Cuxton Pit No. 3, Strood LWS	County	Moderate adverse	Slight adverse **Not significant**
Dartford Marshes LWS	County	No change	Neutral **Not significant**
Disused Railway Cutting, Longfield LWS	County	Negligible adverse	Neutral **Not significant**
Frith Woods Etc., Kits Coty LWS	County	Negligible adverse	Neutral **Not significant**
Leybourne Lakes Etc., Snodland LWS	County	No change	Neutral **Not significant**
River Medway And Marshes, Wouldham LWS	County	No change	Neutral **Not significant**
River Medway Between Cuxton And Temple Marsh LWS	County	Minor adverse	Neutral **Not significant**
St Michael And All Angels Church LWS	County	Moderate adverse	Slight adverse **Not significant**
Woodlands West of Shoreham LWS	County	Negligible adverse	Neutral

Designated site (AW – ancient woodland. VT – veteran tree)	Importance	Level of impact	Effect
			Not significant
Yaugher Woods LWS	County	Negligible adverse	Neutral **Not significant**
River Shuttle SINC	County	Negligible adverse	Neutral **Not significant**
Cobham Woods SSSI	National	Major adverse	Large adverse **Significant**
Great Crabbles Wood SSSI	National	Negligible adverse	Slight adverse **Not significant**
Halling To Trottiscliffe Escarpment SSSI	National	Moderate adverse	Moderate adverse **Significant**
Shorne And Ashenbank Woods SSSI (construction and operational impacts)	National	Major adverse	Large adverse **Significant**
Titsey Woods SSSI	National	Negligible adverse	Slight adverse **Not significant**
Westerham Wood SSSI	National	Negligible adverse	Slight adverse **Not significant**
Wouldham To Detling Escarpment SSSI	National	Major adverse	Large adverse **Significant**
23_VT	National	Minor adverse	Slight adverse **Not significant**
27_VT	National	Negligible adverse	Slight adverse **Not significant**
401_VT	National	Negligible adverse	Slight adverse **Not significant**
403_VT	National	Negligible adverse	Slight adverse **Not significant**
410_VT	National	Minor adverse	Slight adverse **Not significant**
424_VT	National	Negligible adverse	Slight adverse **Not significant**
438_VT	National	Minor adverse	Slight adverse **Not significant**
643_VT	National	Negligible adverse	Slight adverse **Not significant**
649_VT	National	Negligible adverse	Slight adverse **Not significant**

Designated site (AW – ancient woodland. VT – veteran tree)	Importance	Level of impact	Effect
652_VT	National	Negligible adverse	Slight adverse **Not significant**
667_VT	National	Negligible adverse	Slight adverse **Not significant**
668_VT	National	Negligible adverse	Slight adverse **Not significant**
669_VT	National	Negligible adverse	Slight adverse **Not significant**
670_VT	National	Negligible adverse	Slight adverse **Not significant**
671_VT	National	Negligible adverse	Slight adverse **Not significant**
744_VT	National	Minor adverse	Slight adverse **Not significant**
745_VT	National	Minor adverse	Slight adverse **Not significant**
752_VT	National	Minor adverse	Slight adverse **Not significant**

8.6.445 Where significant effects are predicted to occur on designated habitats within 200m of the ARN as a result of increased nitrogen deposition on those sites, measures to address the adverse effects would be implemented. Avoidance was achieved as far as possible within the Project's objectives through design. A number of potential mitigation options were considered and feasible mitigation measures (in the form of speed enforcement measures on the M2) have been proposed to minimise the residual significant effects. A number of potential compensation measures were considered, and feasible measures have been proposed. Although these measures would not act to reduce the adverse effects of nitrogen deposition on designated sites, they are considered appropriate to fully compensate for residual significant effects (see Project Air Quality Action Plan (Application Document 6.3, Appendix 5.6).

8.6.446 The compensation strategy proposed consists of landscape scale habitat creation across four Nitrogen Deposition Compensation Sites located south of the river, and three north of the river, totalling an area of approximately 205ha. The objectives of these is to both increase the amount of high quality wildlife-rich habitat, and position this new habitat to forge strong links between areas of retained semi-natural habitat within the network of designated sites across the wider landscape (see Figure 2.4: Environmental Masterplan (Application Document 6.2), and the Design Principles (Application Document 7.5) Clause no. LSP.27). This would build resilience of the ecological networks that support the nitrogen deposition affected sites and therefore build the resilience of the affected sites themselves (see Project Air Quality Action Plan (Application Document 6.3, Appendix 5.6)). The precise design of the habitats to be created

at each Nitrogen Deposition Compensation Site would be developed during detailed design, but given the habitats affected by nitrogen deposition are predominantly woodland and grassland, the outline habitat creation proposals would see lowland mixed deciduous woodland and lowland meadow priority habitats created at a roughly 70% to 30% mix respectively at a landscape scale. Priority habitats have been used as the target habitat type to provide high distinctiveness wildlife-rich habitats. Their creation and time to establishment is longer than less distinct habitats, and would require specific management prescriptions. Details of the strategy and the consideration of the mitigation hierarchy can be seen in the Project Air Quality Action Plan (Application Document 6.3, Appendix 5.6). Details of the management and monitoring proposals are provided within the oLEMP (Application Document 6.7).

8.6.447 There is potential for indirect impacts associated with pollution from vehicles entering watercourses, which in turn could affect the vegetation and faunal communities within the statutory designated sites listed in Section 8.4. However, the Project design and mitigation measures outlined in Chapter 14: Road Drainage and the Water Environment (Section 14.5) for managing surface water runoff from the highway include provision of appropriate measures for treatment of surface water. The inclusion of the mitigation outlined in Chapter 14: Road Drainage and the Water Environment (Section 14.5) would avoid impacts and result in effects on statutory and non-statutory designated sites that are considered to be neutral and not significant.

8.6.448 Habitat degradation and disturbance of species present within statutory and non-statutory designated sites from increased visitor pressure has been considered as part of the assessment of likely operational phase effects. Chapter 13: Population and Human Health includes a review of how the Project might alter the use of specific sites by visitors, including sites that are designated for their biodiversity importance. This demonstrates that although the specific locations at which some sites will be accessed would change as a result of the Project, the numbers of recreational users of the sites would be unlikely to change considerably. Therefore, likely significant effects on the biodiversity resources within the sites are not predicted. This is considered further in Chapter 13: Population and Human Health. In addition, sites such as Chalk Park have been designed to offer recreational space for the general public. Further detail on these sites is given in the Planning Statement Appendix D (Application Document 7.2).

Plants and habitats

8.6.449 The likely effects of the operational phase on plants and habitats would be habitat degradation.

8.6.450 There is potential for indirect effects, particularly on water bodies and watercourses, associated with pollution from incidents such as traffic collisions. Assessments undertaken within Appendices 14.3 and 14.4 (Application Document 6.3) have found risks to ground and surface waters are below the acceptable thresholds set out in LA 113 of the DMRB (1% annual chance, or 0.5% annual chance in the vicinity of a sensitive site such as the Ramsar) resulting in a temporary negligible adverse level of impact. Overall, the likely effect on plants and habitats is considered to be neutral and **not significant**.

Terrestrial invertebrates

8.6.451 The likely effects associated with the operational phase on terrestrial invertebrates would be:

a. Disturbance

8.6.452 **Disturbance:** Nocturnal species attracted to light (in particular, moths but other invertebrate species) could suffer disturbance during the operational phase from bright lighting associated with the Project in close proximity to retained and newly created habitats. This could reduce the abundance and diversity of species and increase the susceptibility of individuals to mortality through increased predation.

8.6.453 The operation phase lighting design would be designed as part of the Project design and mitigation measures to preserve nocturnal character and habitats, and maintain dark corridors for wildlife (Design Principles (Application Document 7.5) Clause no. LST.02; LST.03). The lux contours modelled have shown that within the woodland areas around the A2/M2, the lux level would fall to 0.5 lux immediately behind the treeline from the operational lighting of the Project. Around the South Portal, the lighting levels would fall to 0.5 lux within 30m of the Project (please refer to Appendix 8.15: Construction and Operational Light Spill Calculations (Application Document 6.3)).

8.6.454 The inclusion of the mitigation measures in the operation phase lighting design would reduce the level of impact such that there would be no observable change to the characteristics of the nationally and regionally important invertebrate populations and therefore effects that are considered to be neutral and **not significant**.

Freshwater species

8.6.455 The freshwater receptors have been combined in this section as impacts are likely to be similar across all receptors. Potential impacts associated with the operational phase are:

a. Habitat degradation

8.6.456 **Habitat degradation:** The tunnels associated with the Project would extend beneath the Thames Estuary and Marshes Ramsar site and South Thames Estuary and Marshes SSSI at Filborough Marshes. This could have the potential to lead to reduced water levels within the ditch system associated with the designated site. This could significantly affect the macro-invertebrate communities, which are of county importance, that inhabit the ditches, through habitat loss. However, groundwater level data from boreholes within the Ramsar site suggests that there is insufficient hydraulic head difference to drive net flow from the study area to the lower strata (refer to Appendix 14.4: Hydromorphology Assessment (Application Document 6.3)). The level of impact on the receptors would therefore be no change, resulting in effects that are neutral and **not significant**.

Amphibians

8.6.457 The likely effects of the operational phase on amphibians would be:

a. Direct mortality

b. Habitat degradation

c. Fragmentation

8.6.458 **Direct mortality**: The Project poses a direct risk to amphibians during operation through collision with vehicles and animals getting trapped within the drainage system. Populations S3 and S4 (see Figure 8.8 (Application Document 6.2)) are located over 1km from the proposed new carriageway and therefore this does not pose a risk. Populations S1 and S2 (see Figure 8.8 (Application Document 6.2)) are already near to the existing major road network along the A2/M2 and works to these existing roads are considered to have a negligible effect. To reduce the risk of any GCN fatalities, the use of gully pots within the drainage design would be avoided where a viable alternative is available (Design Principles (Application Document 7.5) Clause no. LSP.28). As such, there is considered to be no change in the level of impact and therefore, the overall residual effects on the GCN populations, which are of county importance, would be neutral and **not significant**.

8.6.459 **Habitat degradation**: There is potential for indirect effects, particularly on water bodies and watercourses, associated with pollution from incidents such as traffic collisions, runoff containing salt in winter, etc. Assessments undertaken within Appendices 14.3 and 14.4 (Application Document 6.3) have found risks to ground and surface waters are below the acceptable thresholds set out in DMRB LA 113 (Highways England, 2020d) (1% annual chance, or 0.5% annual chance in the vicinity of a sensitive site such as the Ramsar) resulting in a temporary negligible adverse impact. Overall, the likely effect on the GCN populations, which are of county importance, is considered to be neutral and **not significant**.

8.6.460 **Fragmentation**: Populations S1 and S2 (see Figure 8.8 (Application Document 6.2)) are located either side of the existing A2/M2, which is already considered to be a significant existing barrier to GCN movements. The widening of this road to facilitate the new carriageway would not cause any further fragmentation for these populations. Other GCN populations (S3 and S4, see Figure 8.8 (Application Document 6.2)) are located sufficiently far from the proposed carriageway (over 1km) to avoid fragmenting their habitats and severing the connections to other GCN populations. Furthermore, the successful implementation of the Project design and mitigation measures (see Section 8.5), particularly the proposed woodland habitat creation and creation of green bridges (Figure 2.4: Environmental Masterplan (Application Document 6.2), and Design Principles (Application Document 7.5) Clause no. LSP.02, PRO.04, PLA.05, S2.03, S2.01, S1.14, S1.13, S1.08, S1.01, STR.01, STR.08), would create a largely unbroken corridor which would facilitate the future movement of GCN between populations. As such, there is considered to be no change in the level of impact caused through fragmentation and the overall residual effects on the GCN populations, which are of county importance, would therefore be neutral and **not significant.**

Reptiles

8.6.461 No impacts on reptiles associated with the operational phase of the Project are considered likely. The effects would therefore be neutral and **not significant**.

Ornithology

8.6.462 The likely effects of the operational phase on the general bird assemblage would be:

a. Direct mortality

b. Disturbance

8.6.463 **Direct mortality:** Certain low-flying species such as thrushes and game birds are at a greater risk of collision with vehicles during the operation of the Project. Collision risk is greatest where hedgerows and woodland habitat directly adjoins the carriageway. The Project design and mitigation measures, as outlined in Section 8.5, include steep cuttings, unvegetated drainage verges and green bridges over the carriageways, which would discourage birds from flying directly across the highway and subsequently reduce the risk of direct mortality through collisions. Although the impact cannot be avoided entirely, any residual impact on the general bird assemblage would be irreversible permanent minor adverse and not sufficient to affect the conservation status of the bird populations. The overall residual effect on the bird assemblage, which is of county importance, would therefore be slight adverse and **not significant**.

8.6.464 **Disturbance:** It is feasible that the impact of increased noise and lighting from the highway during the operational phase could cause disturbance effects on birds, resulting in changes in bird behaviour and a reduction in the local distribution of species. The inclusion of the Project design and mitigation measures outlined in Chapter 12: Noise and Vibration (Section 12.5), including noise screening barriers, placing the Project in cutting/false cutting, would however reduce the residual impacts on the general bird assemblage.

8.6.465 The operation phase lighting design would be designed as part of the Project design and mitigation measures to preserve nocturnal character and habitats, and maintain dark corridors for wildlife (Design Principles (Application Document 7.5) Clause no. LST.02; LST.03). The lux contours modelled have shown that within the woodland areas around the A2/M2, the lux level would fall to 0.5 lux immediately behind the treeline from the operational lighting of the Project. Around the South Portal, the lighting levels will fall to 0.5 lux within 30m of the Project (please refer to Appendix 8.15: Construction and Operational Light Spill Calculations (Application Document 6.3).

8.6.466 The residual impact on the general bird assemblage would be irreversible permanent minor adverse, and would therefore be slight adverse effect and **not significant**.

8.6.467 No impacts on birds other than those outlined above for the general bird assemblage would be likely to occur during the operational phase of the Project to the south of the River Thames. The South Portal is sufficiently far from the shoreline of the River Thames and the marsh habitats that form part of the qualifying features of the Thames Estuary and Marshes SPA and Ramsar site that impacts on birds associated with these sites, including marsh harrier, would

be unlikely during the operational phase. The effects on the bird assemblage, which is of county importance, would therefore be neutral and **not significant**.

Bats

8.6.468 The likely effects of the operational phase on bats to the south of the River Thames would be:

a. Direct mortality

b. Disturbance

c. Habitat fragmentation

8.6.469 **Direct mortality:** To the south of the River Thames, three green bridges and associated landscape planting have been designed to reduce the likelihood of bats crossing the Project over the carriageways, and therefore reduce the risk of any collisions with traffic (Figure 2.4: Environmental Masterplan (Application Document 6.2) and Design Principles (Application Document 7.5) Clause no. LSP.02, PLA.05, STR.08, S2.04). The Thong Lane green bridge north provides connectivity to a currently fragmented habitat used by bats and would maintain the connectivity from Claylane Wood to Shorne Woods. The remaining two green bridges are in locations where the A2 is already fragmenting habitats. The inclusion of the green bridges would provide a safer crossing than currently available in the area. They would also provide improved connectivity between Ashenbank Wood and Shorne Woods.

8.6.470 The inclusion of steep cuttings and unvegetated drainage verges within the design would also reduce the likelihood of bats foraging near the carriageways and seeking to commute directly across it (Figure 2.4: Environmental Masterplan (Application Document 6.2) and Design Principles (Application Document 7.5) Clause no. LSP.09). The inclusion of these Project design measures would result in an irreversible permanent minor adverse level of impact on the bat assemblage, which is of county importance, and effects that are considered to be slight adverse and **not significant**.

8.6.471 **Disturbance:** During the operational phase of the Project, it is feasible that light, noise and visual disturbance of foraging and commuting bats could occur. The lighting design has been designed to decrease the impact of light on adjacent habitats and biodiversity features (for full details refer to Appendix 8.15 (Application Document 6.3)). The majority of this section of the Project will be lit. However, the lighting will include downlighting and a range of different sized columns to reduce light spill (see the Design Principles (Application Document 7.5) Clause no. LST.02). The lighting assessment has shown that the lux level falls to 0.5 lux within 30m of the route (please refer to Appendix 8.15: Construction and Operational Light Spill Calculations (Application Document 6.3).

8.6.472 The area south of the River Thames is subject to high levels of traffic, particularly the A2/M2 and A226, and while traffic noise does disturb bats, the local population would be expected to be habituated to this, as evidenced by the fact there are roosts close to existing roads. The noise and visual disturbance effects would be reduced by both noise and visual screening, as outlined in Chapter 12: Noise and Vibration (Section 12.5). Noise modelling has shown that

there will be a negligible increase, or reduction, in noise levels from the operation phase of the Project.

8.6.473 The inclusion of these Project design and mitigation measures would result in an irreversible permanent minor adverse level of impact on the bat assemblage, which is of county importance, and effects that are considered to be slight adverse and **not significant**.

8.6.474 **Habitat fragmentation**: The commuting and foraging route identified to the north of the A2 (Crossing Point 0.5; refer to Appendix 8.8 (Application Document 6.3) and Figure 8.25 (Application Document 6.2)) would be lost. However, the creation of the three green bridges, in particular the Thong Lane north green bridge, would reduce the likelihood of habitat fragmentation. In addition, the extensive planting scheme will provide connectivity to the green bridge. The inclusion of these Project design and mitigation measures would result in an irreversible permanent minor adverse level of impact on the bat assemblage, which is of county importance, and effects that are considered to be slight adverse and **not significant**.

Dormice

8.6.475 No impacts associated with the operational phase of the Project on dormouse are considered likely. The potential risk of mortality of dormouse would be addressed through the provision of green bridges and landscape planting, which would avoid the need for dormouse to attempt to cross the operational carriageways. The lighting assessment has shown that the lux level falls to 0.5 lux within 30m of the route (please refer to Appendix 8.15: Construction and Operational Light Spill Calculations (Application Document 6.3), and therefore wouldn't affect adjacent dormice habitat. The effects on the dormouse population, which is of county importance, would therefore be neutral and **not significant**.

Water voles

8.6.476 No impacts associated with the operational phase of the Project on water vole are considered likely. The effects on the water vole population, which is of regional importance, would therefore be neutral and **not significant**.

Otters

8.6.477 No impacts associated with the operational phase of the Project on otter are considered likely. The effects on otter, which are locally important, would therefore be neutral and **not significant**.

Badgers

8.6.478 The likely effects of the operational phase on badger to the south of the River Thames would be:

a. Direct mortality

b. Disturbance

c. Habitat fragmentation

8.6.479 **Direct mortality**: To the south of the River Thames, three green bridges have been proposed to reduce the likelihood of badgers crossing the Project over the carriageway, which would reduce the likelihood of collisions with traffic as shown in Figure 2.4: Environmental Masterplan (Application Document 6.2) and described in detail in Section 8.5. In addition, badger fencing would be installed to direct animals to these crossing locations as detailed in Section 8.5.

8.6.480 The level of impact on badgers, which are locally important, would therefore be irreversible permanent minor adverse and result in effects that would be slight adverse and **not significant**.

8.6.481 **Disturbance:** During the operational phase of the Project it is feasible that light, noise and visual disturbance of badger could occur. Any likely disturbance effects would be reduced by both noise and visual screening, as outlined in Chapter 12: Noise and Vibration (Section 12.5). The lighting assessment has shown that the lux level falls to 0.5 lux within 30m of the route (please refer to Appendix 8.15: Construction and Operational Light Spill Calculations (Application Document 6.3). Furthermore, badgers are highly tolerant of traffic disturbance, as evidenced by the presence of setts within close proximity to the A2/M2 within the study area.

8.6.482 The inclusion of these Project design and mitigation measures would result in an irreversible permanent minor adverse level of impact on badgers, which are of local importance, and effects that are considered to be slight adverse and **not significant**.

8.6.483 **Habitat fragmentation**: The operation of the Project would result in fragmentation of habitat to the south of the River Thames. The provision of three green bridges would ensure that commuting routes are available that allow badgers to move within the wider landscape as shown in Figure 2.4: Environmental Masterplan (Application Document 6.2) and described in detail in Section 8.5.

8.6.484 As such, any fragmentation impacts would be irreversible permanent minor adverse and result in effects on badgers, which are locally important, that would be slight adverse and **not significant**.

River Thames

8.6.485 The likely effects of operation on ecological receptors include the following:

a. Disturbance – noise and visual disturbance of species present

Statutory designated sites

Thames Estuary and Marshes SPA and Ramsar

8.6.486 The operation of the Project and the recreational use of Tilbury Fields has the potential to lead to disturbance of the bird assemblages using functionally linked land associated with the Thames Estuary and Marshes SPA and Ramsar. The landscape design would allow public access to informal footpaths and viewpoints that would be screened to prevent significant visual intrusion to waterbirds using the estuary. Interpretation boards along footpaths and publicly accessible areas would highlight the importance and sensitivity of the Thames estuary for nature (Design Principles (Application Document 7.5) Clause no. S9.02, S9.18). The new habitat creation area of wet grassland, ditches and

scrapes at Coalhouse Point, to the west of Coalhouse Fort, would provide alternative foraging habitat. Design Principles (Application Document 7.5) Clause no. S9.13, secures the enhanced habitat areas to avoid and reduce the effect of habitat loss and disturbance within the functionally linked land associated with the Thames Estuary and Marshes SPA and Ramsar site.

8.6.487 As such, any disturbance impacts would not be considered to result in any damage to the integrity of the Thames Estuary and Marshes SPA and Ramsar site, and there would be no observable impact. The effect would therefore be neutral and **not significant**.

Otters

8.6.488 No impacts associated with the operational phase of the Project on otter are considered likely. The effects on otter, which are locally important, would therefore be neutral and **not significant**.

North of the River Thames

8.6.489 The likely effects of operation on ecological receptors include the following:

a. Habitat loss – direct loss of habitat as a result of the operation of the Project

b. Direct mortality – operation of the Project causing direct mortality

c. Fragmentation – preventing animals dispersing and moving within the wider landscape

d. Habitat degradation – causing the habitat to become suboptimal, for example through changes in air quality, specifically nitrogen deposition, and pollution events

e. Disturbance – noise and visual disturbance of species present, including from anthropomorphic influences

Statutory and non-statutory designated sites

8.6.490 No direct impacts are anticipated on any statutory and non-statutory designated sites during the operation of the Project. In the absence of mitigation, effects from habitat degradation could however occur.

8.6.491 There is potential for effects associated with increased nitrogen deposition on designated habitats within close proximity to the new carriageway and the ARN from traffic emissions (see Section 5.5 of Chapter 5: Air Quality). Appendix 8.14: Designated Sites Air Quality Assessment (Application Document 6.3), considers the effects of nitrogen deposition on designated sites which require further consideration in line with DMRB LA 105 Air Quality (Highways England, 2020b). A summary table of the conclusions of Appendix 8.14 is presented in Table 8.38 below. Where sites are affected by both construction and operational increases in nitrogen deposition, these are identified, and the assessment takes into account the cumulative durational effect of sites experiencing increased nitrogen deposition during both the construction and operational phase of the Project.

Table 8.38 Designated habitats north of the River Thames – air quality impact summary

Designated site	Importance	Level of impact	Effect
AW_Theme_ID1420012 AW	National	Major adverse	Large adverse **Significant**
Barber's Wood AW	National	Moderate adverse	Moderate adverse **Significant**
Chadwell Wood (AW_Theme_ID 1119923) AW	National	Negligible adverse	Slight adverse **Not significant**
Codham Hall Wood AW (construction and operational impacts)	National	Major adverse	Large adverse **Significant**
Epping-Ambresbury Banks AW	National	Negligible adverse	Slight adverse **Not significant**
Hall Wood AW	National	Minor adverse	Slight adverse **Not significant**
Hobbs Hole AW (construction and operational impacts)	National	Minor adverse	Slight adverse **Not significant**
Shales More AW	National	Negligible adverse	Slight adverse **Not significant**
The Osiers AW	National	Negligible adverse	Slight adverse **Not significant**
All Saints Grassland LWS	County	Negligible adverse	Neutral **Not significant**
Barber's Wood and Lane LWS	County	Moderate adverse	Slight adverse **Not significant**
Bowers Gifford Grasslands LWS	County	Negligible adverse	Neutral **Not significant**
Codham Hall Woods LWS (construction and operational impacts)	County	Major adverse	Moderate adverse **Significant**
Copped Hall Green LWS	County	Negligible adverse	Neutral **Not significant**
Goshems Farm LWS	County	Minor adverse	Neutral **Not significant**
Hall/Gravelhill Woods LWS	County	Minor adverse	Neutral **Not significant**
Hobbs Hole LWS (construction and operational impacts)	County	Minor adverse	Slight adverse **Not significant**
Linford Pit LWS	County	Minor adverse	Neutral **Not significant**

Designated site	Importance	Level of impact	Effect
Low Street Pit LWS	County	No change	Neutral **Not significant**
Mucking Heath LWS	County	Minor adverse	Neutral **Not significant**
Parker's Shaw LWS	County	Minor adverse	Neutral **Not significant**
Rainbow Shaw LWS	County	No change	Neutral **Not significant**
Shales More LWS	County	Negligible adverse	Neutral **Not significant**
Terrels Heath Grays LWS	County	Negligible adverse	Neutral **Not significant**
The Oaks LWS	County	No change	Neutral **Not significant**
The Selvage LWS	County	Negligible adverse	Neutral **Not significant**
Epping Forest SAC	International	Negligible adverse	Slight adverse **Not significant**
Broom Hill SINC	County	Moderate adverse	Slight adverse **Not significant**
Buckingham Hill SINC	County	Major adverse	Slight adverse **Not significant**
Curtis Plantation SINC	County	Moderate adverse	Slight adverse **Not significant**
Folkes Lane Woodland SINC	County	Major adverse	Slight adverse **Not significant**
Foxburrow Wood, Upminster SINC	County	Major adverse	Slight adverse **Not significant**
Franks Wood And Cranham Brickfields SINC	County	Minor adverse	Neutral **Not significant**
Hillview SINC	County	Moderate adverse	Slight adverse **Not significant**
Ingrebourne Valley SINC	County	Negligible adverse	Neutral **Not significant**
Jermains Wood SINC	County	Minor adverse	Neutral **Not significant**
Lea Valley SINC	County	No change	Neutral **Not significant**

Designated site	Importance	Level of impact	Effect
Little Chef Pasture SINC	County	Minor adverse	Neutral **Not significant**
Ockendon Railsides SINC (construction and operational impacts)	County	Major adverse	Moderate adverse **Significant**
Pot Kiln Wood and Sickle Wood SINC	County	Negligible adverse	Neutral **Not significant**
Romford To Harold Wood Railsides SINC	County	Negligible adverse	Neutral **Not significant**
Strawberry Farm Wood SINC	County	Moderate adverse	Slight adverse **Not significant**
Thames Chase Forest Centre SINC (construction and operational impacts)	County	Major adverse	Slight adverse **Not significant**
Tylers Wood SINC	County	Minor adverse	Neutral **Not significant**
Upminster Lodge Farm Horse Field SINC	County	Moderate adverse	Slight adverse **Not significant**
Epping Forest SSSI	National	Negligible adverse	Slight adverse **Not significant**
Langdon Ridge SSSI	National	No change	Neutral **Not significant**
426_VT	National	Minor adverse	Slight adverse **Not significant**

8.6.492 Where significant effects are predicted to occur on designated habitats within 200m of the ARN as a result of increased nitrogen deposition on those sites, measures to address the adverse effects would be implemented. Avoidance was achieved as far as possible within the Project's objectives through design. A number of potential mitigation options were considered and feasible mitigation measures (in the form of speed enforcement measures on the M2) have been proposed to minimise the residual significant effects. A number of potential compensation measures were considered, and feasible measures have been proposed. Although these measures would not act to reduce the adverse effects of nitrogen deposition on designated sites, they are considered appropriate to fully compensate for residual significant effects (see Project Air Quality Action Plan (Application Document 6.3, Appendix 5.6).

8.6.493 The compensation strategy proposed consists of landscape scale habitat creation across four Nitrogen Deposition Compensation Sites located south of the river, and three north of the river, totalling an area of approximately 205ha. The objectives of these is to both increase the amount of high quality wildlife-rich habitat, and position this new habitat to forge strong links between areas of retained semi-natural habitat within the network of designated sites across the wider landscape (see Figure 2.4: Environmental Masterplan (Application Document 6.2), and the Design Principles (Application Document 7.5) Clause

no. LSP.27). This would build resilience of the ecological networks that support the nitrogen deposition affected sites and therefore build the residence of the affected sites themselves (see Project Air Quality Action Plan (Application Document 6.3, Appendix 5.6)). The precise design of the habitats to be created at each Nitrogen Deposition Compensation Site would be developed during detailed design, but given the habitats affected by nitrogen deposition are predominantly woodland and grassland, the outline habitat creation proposals would see lowland mixed deciduous woodland and lowland meadow priority habitats created at a roughly 70% to 30% mix respectively at a landscape scale. Priority habitats have been used as the target habitat type to provide high distinctiveness wildlife-rich habitats. Their creation and time to establishment is longer than less distinct habitats, and would require specific management prescriptions. Details of the strategy and the consideration of the mitigation hierarchy can be seen in the Project Air Quality Action Plan (Application Document 6.3, Appendix 5.6). Details of the management and monitoring proposals are provided within the oLEMP (Application Document 6.7).

8.6.494 There is potential for indirect impacts associated with pollution from vehicles entering watercourses, which in turn could affect the vegetation and faunal communities within the statutory and non-statutory designated sites listed in Section 8.4. However, the Project design and mitigation measures (outlined in Chapter 14: Road Drainage and the Water Environment) for managing surface water runoff from the highway, include provision of appropriate measures for treatment of surface water.

8.6.495 The inclusion of the mitigation outlined in Chapter 14: Road Drainage and the Water Environment would avoid impacts and result in effects on statutory and non-statutory designated sites that are considered to be neutral and **not significant**.

8.6.496 Habitat degradation and disturbance of species present within statutory and non-statutory designated sites from increased visitor pressure has been considered as part of the assessment of likely operational phase effects. Chapter 13: Population and Human Health includes a review of how the Project might alter the use of specific sites by visitors, including sites that are designated for their biodiversity importance. This demonstrates that although the specific locations at which some sites will be accessed would change as a result of the Project, the numbers of recreational users of the sites will be unlikely to change considerably. Therefore, likely significant effects on the biodiversity resources within the sites are not predicted. This is considered further in Chapter 13: Population and Human Health.

Plants and habitats

8.6.497 The likely effects of the operational phase on plants and habitats would be habitat degradation.

8.6.498 There is potential for indirect effects, particularly on water bodies and watercourses, associated with pollution from incidents such as traffic collisions. Assessments undertaken within Appendices 14.3 and 14.4 (Application Document 6.3) have found risks to ground and surface waters are below the acceptable thresholds set out in LA 113 of the DMRB (1% annual chance of pollution events occurring) resulting in a temporary small-scale negligible

adverse level of impact. Overall, the likely effect is considered to be neutral and **not significant**.

Terrestrial invertebrates

8.6.499 The likely effects associated with the operational phase on terrestrial invertebrates within areas of national, regional and county importance would be disturbance.

8.6.500 Nocturnal species attracted to light (in particular, moths but also other invertebrate species) could suffer disturbance during the operational phase from bright lighting associated with the Project near to retained and newly created habitats. This could reduce the abundance and diversity of species and increase the susceptibility of individuals to mortality through increased predation.

8.6.501 The operation phase lighting would be designed as part of the Project design and mitigation measures to preserve nocturnal character and habitats, and maintain dark corridors for wildlife (Design Principles (Application Document 7.5) Clause no. LST.02, LST.03). Assessment of the operation phase lighting has shown that within 30m the lux level has fallen to 0.5 lux (please refer to Appendix 8.15: Construction and Operational Light Spill Calculations (Application Document 6.3).

8.6.502 The inclusion of the mitigation measures in the operation phase lighting design would reduce the level of impact such that there would be no observable change to the characteristics of the invertebrate populations; therefore, effects are considered to be neutral and **not significant**.

Freshwater species

8.6.503 The freshwater receptors have been combined in this section as impacts are likely to be similar across all receptors. Potential impacts associated with the operational phase are:

a. Deterioration in water quality

b. Habitat degradation

8.6.504 **Deterioration in water quality:** The North Portal water drainage is planned to be discharged into the Tilbury Main. This could have potential to alter water quality within the Tilbury Main, due to the potential of pollutants leaching into the water from the surrounding area. However, pumping of water from the North Portal to the Tilbury Main would only take place when the water meets relevant environmental quality standards. For full details see the Chapter 14: Road Drainage and the Water Environment. The level of impact would therefore be no change, resulting in effects that would be neutral and **not significant**.

8.6.505 **Habitat degradation:** The installation of culverts and viaducts in/over the ditches and main water bodies, have the potential to shade stretches of watercourse. This is likely to reduce the abundance of macrophytes present in these areas, which some macro-invertebrates use as habitat. The small stretches of watercourse likely to be affected by shading in relation to the overall resource available means that the level of impact on freshwater

receptors would be irreversible permanent minor adverse, resulting in effects that are slight adverse and **not significant**.

Amphibians

8.6.506 The likely effects of the operational phase on amphibians would be:

a. Direct mortality

b. Habitat degradation

c. Fragmentation

8.6.507 **Direct mortality**: The Project poses a direct risk to amphibians during operation through collision with vehicles and animals getting trapped within the drainage design. The majority of the GCN populations to the north of the River Thames are located either away from the proposed new carriageway or are already within close proximity to the existing road network namely the M25 and the A13. For those populations which are closer to the Project, namely population S2 and S7 located 125m and 160m from the proposed carriageway, respectively, there is potential for animals to enter the live road network. However, high quality habitat is located within close proximity to the ponds and habitat quality nearer the breeding ponds will be improved through the landscape design (Figure 2.4: Environmental Masterplan (Application Document 6.2)). As a result, the number of GCN foraging or dispersing across the carriageway are predicted to be very low. To reduce the risk of any GCN fatalities, the use of gully pots within the drainage design would be avoided where a viable alternative is available (Design Principles (Application Document 7.5) Clause no. LSP.28). Although there is a slight risk to small numbers of GCN through direct mortality, any residual impact on the local population is considered to be irreversible permanent minor adverse, not affecting the conservation status of the population as a whole, which is of county importance. The overall residual effect would therefore be slight adverse and **not significant**.

8.6.508 **Habitat degradation**: There is potential for indirect effects, particularly on water bodies and watercourses, associated with pollution from vehicles. Assessments undertaken within Appendices 14.3 and 14.4 (Application Document 6.3) have found risks to ground and surface waters are below the acceptable thresholds set out in LA 113 of the DMRB (1% annual chance) resulting in a small-scale temporary negligible adverse level of impact. Overall, the likely effect on the GCN populations, which are of county importance, would be neutral and **not significant**.

8.6.509 **Fragmentation:** The Project is not considered to create a permanent barrier to GCN movements between existing breeding ponds in the same metapopulation and valuable terrestrial habitat for foraging or hibernation associated with that metapopulation. Despite this, the new carriageway could create a barrier to any likely future dispersal of GCN, should the population expand in the local area. However, the successful implementation of the Project design and mitigation measures (see Section 8.5), particularly the proposed woodland habitat creation and creation of green bridges (Design Principles (Application Document 7.5) Clause no. LSP.02, PLA.05, STR.08, S9.11, S12.02, S12.10, S14.03, and Figure 2.4: Environmental Masterplan (Application Document 6.2)), would create a largely unbroken corridor which would facilitate the movement of GCN between populations. As such, there is considered to be a reversible temporary negligible adverse level of impact and the overall residual effect of

fragmentation on GCN populations, which are of county importance, would therefore be slight adverse and **not significant**.

Reptiles

8.6.510 No impacts on reptiles associated with the operational phase of the Project are considered likely. The effects would therefore be neutral and **not significant**.

Ornithology

8.6.511 The likely effects of the operational phase on the general bird assemblage would be:

a. Direct mortality

b. Disturbance

8.6.512 **Direct mortality:** Certain low-flying species such as thrushes and game birds are at a greater risk of collision with vehicles during the operation of the Project. Collision risk is greatest where hedgerows and woodland habitat directly adjoins the carriageway. The Project design and mitigation measures, as outlined in Section 8.5, include steep cuttings, false cuttings, unvegetated drainage verges and green bridges over the carriageways, which would discourage birds from flying directly across the highway and subsequently reduce the risk of direct mortality through collisions. Although the impact cannot be avoided entirely, any residual impact on the general bird assemblage would be irreversible permanent minor adverse and not sufficient to affect the conservation status of the bird populations, which are of regional importance. The overall residual effect would be slight adverse and **not significant**.

8.6.513 **Disturbance**: It is feasible that the impact of increased noise and lighting from the highway during the operational phase could cause disturbance effects on birds, resulting in changes in bird behaviour and a reduction in the local distribution of species. The lighting assessment has shown that within 30m the lux levels would fall to 0.5 lux (please refer to Appendix 8.15: Construction and Operational Light Spill Calculations (Application Document 6.3)). The inclusion of the Project design and mitigation measures outlined in Chapter 12: Noise and Vibration would however reduce the residual impacts on the general bird assemblage to an irreversible permanent minor adverse level that would not be sufficient to affect the conservation status of the bird populations, which are of regional importance. The overall residual effect would be slight adverse and **not significant**.

8.6.514 No impacts on birds other than those outlined above for the general bird assemblage, which is of regional importance, would be likely to occur during the operational phase of the Project to the north of the River Thames. The North Portal is sufficiently far from the shoreline of the River Thames and the marsh habitats that form part of the qualifying features of the Thames Estuary and Marshes SPA and Ramsar site, that impacts on birds associated with these sites, including marsh harrier, would be unlikely during the operational phase. The effects would therefore be neutral and not significant.

8.6.515 The bird assemblage associated with the Thames Estuary and Marshes SPA and Ramsar site within the study area is further assessed as part of the Habitats Regulations Assessment – Screening Report and Statement to Inform an Appropriate Assessment for the Project (Application Document 6.5). This

also concludes that the effects of the operational phase of the Project on the qualifying bird features of these designated sites would be neutral and **not significant**.

Barn owl

8.6.516 The likely effect of the operational phase on barn owl to the north of the River Thames would be:

a. Direct mortality

b. Disturbance

8.6.517 **Direct mortality:** Barn owls are vulnerable to mortality associated with road traffic collisions, particularly where a major road is at grade or on an embankment that severs existing foraging areas (Shawyer and Dixon, 1999). Existing valuable foraging areas within the ZoI to the north of the River Thames include the marshes and rough grassland between Tilbury Power Station and Coalhouse Fort, and along the Mardyke corridor.

8.6.518 To reduce the potential mortality of barn owls, the Project includes provisions to encourage barn owls to pass safely over the road via green bridges, or under the road by using viaducts (refer to Section 8.5). The inclusion of the Mardyke and Orsett Fen Viaducts would also allow barn owls foraging along this corridor to pass safely beneath the highway (see Figure 2.4: Environmental Masterplan (Application Document 6.2)).

8.6.519 Despite the Project design and mitigation measures outlined above, it is reasonable to predict that barn owl mortality would still be likely, particularly where known nest sites are located within 1.5km of the Project (refer to Section 8.5). Three potential 'blackspots' have been identified, one in the North Portal between the tunnel and the Tilbury Viaduct, with the remaining two found on the embankments either side of the Mardyke. These areas are where it is thought likely that barn owl would be especially vulnerable to collisions. These are due to a combination of current and future valuable foraging habitat (e.g. verge planting and ecological mitigation for other species) surrounding the areas, the design of the Project, and barn owl activity (breeding and foraging) recorded in the vicinity (see Figure 2.4: Environmental Masterplan (Application Document 6.2)).

8.6.520 Measures to compensate for this would be included as part of the Project, including the provision of additional barn owl nest boxes within suitable areas in excess of 1.5km from the Project and other major roads, in an appropriate setting (according to specifications given by Shawyer, 2011) (see the CoCP (Application Document 6.3, Appendix 2.2) (REAC Ref. TB010). The residual level of impact would be likely to be irreversible permanent minor adverse and result in a slight adverse effect that is **not significant** on the barn owl population, which is of county importance.

8.6.521 **Disturbance**: It is feasible that the impact of increased noise and lighting from the highway during the operational phase could cause disturbance effects on barn owls, resulting in changes in bird behaviour and a reduction in the local distribution of species. The lighting assessment has shown that within 30m the lux levels would fall to 0.5 lux (please refer to Appendix 8.15: Construction and

Operational Light Spill Calculations (Application Document 6.3)). The inclusion of the Project design and mitigation measures outlined in Chapter 12: Noise and Vibration would however reduce the residual impacts on the general bird assemblage to an irreversible permanent minor adverse level that would not be sufficient to affect the conservation status of the barn owl populations, which are of county importance. The overall residual effect would be slight adverse and **not significant**.

Bats

8.6.522 The likely effects of the operational phase on bats to the north of the River Thames would be:

a. Direct mortality

b. Disturbance

c. Habitat fragmentation

8.6.523 **Direct mortality:** To the north of the River Thames, four green bridges have been proposed to reduce the likelihood of bats crossing the Project directly over the carriageways (see Figure 2.4: Environmental Masterplan (Application Document 6.2)) and therefore reduce the risk of any collisions with traffic. Green bridges would be tied into the surrounding habitats using landscape planting and new hedgerow creation, particularly in areas where key commuting routes are present (see Design Principles (Application Document 7.5) Clause no. S10.01, S10.03, S12.13; and Figure 2.4: Environmental Masterplan (Application Document 6.2)). All green bridges would be monitored for use by protected species (refer to Section 8.5 and CoCP (Application Document 6.3, ES Appendix 2.2) REAC Ref. TB015).

8.6.524 Additionally, there are three proposed viaducts (one at Tilbury Loop and two over the Mardyke north of the A13) and one oversized box culvert approximately 1.75km west of Coalhouse Fort. The Tilbury Viaduct will be 660m in length and is immediately to the north of the North Portal. This viaduct has a headroom of between 6.8m over the Tilbury Loop railway, which was identified as a key commuting route for bats. The two viaducts at the Mardyke carry the Project over the Orsett Fen Sewer and the Mardyke and Golden Fen Sewer. These two viaducts have a combined length of 550m and a headroom of 6–8m. The proposed viaducts and culvert would also allow access for bats to pass under the Project, ensuring maintenance of commuting and foraging and reducing the potential for collision-related mortality (see Figure 2.4: Environmental Masterplan (Application Document 6.2)).

8.6.525 The inclusion of steep cuttings and unvegetated drainage verges within the design would also reduce the likelihood of bats foraging near the carriageways and seeking to commute directly across it (see Figure 2.4: Environmental Masterplan (Application Document 6.2)). The inclusion of these Project design and mitigation measures would result in an irreversible permanent minor adverse level of impact on the bat assemblage, which is of county importance, and effects that are considered to be slight adverse and **not significant.**

8.6.526 **Disturbance**: During the operational phase of the Project, it is feasible that light, noise and visual disturbance of foraging and commuting bats could occur.

The operation phase lighting would be designed as part of the Project design and mitigation measures to preserve nocturnal character and habitats, and maintain dark corridors for wildlife (Design Principles (Application Document 7.5) Clause no. LST.02; LST.03). The lighting assessment shows that within 30m the lux levels would fall to 0.5 lux (refer to Appendix 8.15 (Application Document 6.3)). Large areas within this section would be unlit, in particular around the green bridges at Hoford Road and Green Lane. The remaining sections that are lit would include downlighting and a range of different sized columns to reduce light spill (see Design Principles (Application Document 7.5) Clause no. LST.02).

8.6.527 Large areas north of the River Thames are subject to high levels of traffic, particularly the M25, A13 and A1089, and while traffic noise does disturb bats, the local population would be expected to be habituated to this, as evidenced by the fact there are roosts close to existing roads. Noise modelling shows that at the majority of roost sites there would be a negligible increase or minor reduction in noise levels from the operation phase of the Project. Tree 1015 and Tree 1036 will have a moderate and major increase in noise levels during the operation phase of the Project. The noise and visual disturbance effects would be reduced by both noise and visual screening, as outlined in Chapter 12: Noise and Vibration. Additionally, a number of artificial bat boxes will be erected to give bats alternative roosts away from these areas where there are increases in noise levels.

8.6.528 The inclusion of these Project design and mitigation measures would result in an irreversible permanent minor adverse level of impact on the bat assemblage, which is of county importance, and effects that are considered to be slight adverse and **not significant**.

8.6.529 **Habitat fragmentation**: To the north of the River Thames, four green bridges have been proposed to reduce the likelihood of bats crossing the Project directly over the carriageways (see Figure 2.4: Environmental Masterplan (Application Document 6.2)) and therefore mitigate the fragmentation effects. Green bridges will be tied into the surrounding habitats using landscape planting and new hedgerow creation, particularly in areas where key commuting routes are present (see Design Principles (Application Document 7.5) Clause no. S10.01, S10.03, S12.13; and Figure 2.4: Environmental Masterplan (Application Document 6.2)). All green bridges would be monitored for use by protected species (refer to Section 8.5 and CoCP (Application Document 6.3, Appendix 2.2) REAC Ref. TB015).

8.6.530 Additionally, there are three proposed viaducts (one at Tilbury Loop and two over the Mardyke north of the A13) and one oversized box culvert approximately 1.75km west of Coalhouse Fort. The Tilbury Viaduct will be 660m in length and is immediately to the north of the North Portal. This viaduct has a headroom of between 6.8m over the Tilbury Loop railway, which was identified as a key commuting route for bats. The two viaducts at the Mardyke carry the Project over the Orsett Fen Sewer and the Mardyke and Golden Fen Sewer. These two viaducts have a combined length of 550m and a headroom of 6–8m. The proposed viaducts and culvert would also allow access for bats to pass under the Project, ensuring maintenance of commuting and foraging and

reducing the potential for fragmentation (see Figure 2.4: Environmental Masterplan (Application Document 6.2)).

8.6.531 These mitigation measures would result in an irreversible permanent minor adverse level of impact on the bat assemblage north of the River Thames, which is of county importance, and would result in effects that are considered to be slight adverse and **not significant**.

Water voles

8.6.532 The likely effects of the operational phase on water vole to the north of the River Thames would be:

a. Direct mortality

b. Disturbance

c. Habitat fragmentation

8.6.533 **Direct mortality**: Water vole are considered unlikely to suffer direct mortality from encountering traffic movements due to their method of commuting through watercourses. Culverts and viaducts have been designed to allow water vole safe passage beneath the highway without encountering the carriageways.

8.6.534 As such, the likely level of impact on the regionally important water vole populations would be no change, resulting in effects that would be neutral and **not significant**.

8.6.535 **Disturbance**: Operational disturbance from light spill and noise, particularly in the vicinity of the watercourses adjacent to the River Thames and the Mardyke, could affect water vole. To mitigate for this the operation phase lighting would be designed as part of the Project design and mitigation measures to preserve nocturnal character and habitats, and maintain dark corridors for wildlife (Design Principles (Application Document 7.5) Clause no. LST.02; LST.03).The lighting assessment has shown that within 30m the lux levels would fall to 0.5 lux (please refer to Appendix 8.15: Construction and Operational Light Spill Calculations (Application Document 6.3)). Noise screening and bunding, as outlined in Chapter 12: Noise and Vibration, has been designed to reduce the noise effects on the wider landscape from the Project (Design Principles (Application Document 7.5) Clause no. STR.10). Furthermore, water vole is known to be a species tolerant of high disturbance levels, often found within busy city centres (Strachan *et al.*, 2011). As such, the likely level of impact on the regionally important water vole populations would be no change, resulting in effects that would be neutral and **not significant**.

8.6.536 **Habitat fragmentation**: Tilbury Main (W021) is being culverted under the Project. The culvert design is a 46m oversized box culvert with an integrated mammal ledge to allow crossings under flood conditions. For full details see Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no. PLA.05, S9.10. There is limited evidence regarding the maximum length of culvert used by water vole before they present a significant barrier to movement. The Water Vole Conservation Handbook (Strachan *et al.*, 2011) states that '*culverting does not seem to provide a major problem to water vole movement or fragmentation*',

although it also states that '*length may present a problem to water vole daily movement and dispersal'.* Mammal ledges within culverts have been included as part of the Project design and mitigation measures. These would allow free movement of water voles through culverts during flood conditions. For full details see Section 8.5 and the Design Principles (Application Document 7.5) Clause no. PLA.05, S9.10.

8.6.537 The Project has been designed to be on a raised viaduct over the watercourses in the vicinity of the Mardyke. For full details see Chapter 2: Project Description. This design will allow free movement of water vole under the Project and will not cause any fragmentation effects on water vole.

8.6.538 Overall, due to the length of the culvert on the Tilbury Main (W021) and the lack of existing evidence of water voles using culverts of the proposed length, it is considered that the operational habitat fragmentation on the regionally important water vole populations could have an irreversible permanent minor adverse level of impact and result in a slight adverse effect that is **not significant**.

Otters

8.6.539 The likely effects of the operational phase on otter to the north of the River Thames would be:

a. Direct mortality

b. Disturbance

c. Habitat fragmentation

8.6.540 **Direct mortality**: Otter are considered unlikely to suffer direct mortality from encountering traffic movements due to their method of commuting through watercourses. Culverts and viaducts have been designed to allow otter safe passage beneath the Project without encountering the carriageways.

8.6.541 As such, the likely level of impact on otter, which are of county importance, would be no change, resulting in effects that would be neutral and **not significant**.

8.6.542 **Fragmentation**: The watercourses adjacent to the River Thames would be considered as a potential commuting route for otter recolonisation north of the River Thames. Tilbury Main (W021) is being culverted under the Project. The culvert design is a 46m oversized box culvert with an integrated mammal ledge to allow crossings under flood conditions. For full details see Section 8.5 and the Design Principles (Application Document 7.5) Clause no. PLA.05, S9.10.

8.6.543 The Project has been designed to be on a raised viaduct over the watercourses in the vicinity of the Mardyke. For full details see Figure 2.4: Environmental Masterplan (Application Document 6.2). An existing culvert under the M25 will be replaced with a new oversized box culvert with an integrated mammal culvert. For full details see Section 8.5, Figure 2.4: Environmental Masterplan (Application Document 6.2) and the Design Principles (Application Document 7.5) Clause no.PLA.05, STR.04, S12.03.

8.6.544 Overall, the likely level of impact from fragmentation on otter, which are of county importance, would be no change, resulting in effects that would be neutral and **not significant**.

8.6.545 **Disturbance**: Operational disturbance from light spill and noise, particularly in the vicinity of the watercourses adjacent to the River Thames and the Mardyke could affect otter. To mitigate for this, the Design Principles (Application Document 7.5) Clause no. LST.02, details mitigation to prevent light spill onto important biodiversity features such as watercourses. Noise screening and bunding, as outlined in Chapter 12: Noise and Vibration has been designed to reduce the noise effects on the wider landscape from the Project. Furthermore, otter is known to be a species tolerant of high disturbance levels, often found within busy city centres (Crawford, 2010).

8.6.546 Therefore, the likely level of impact on otter, which are of county importance, would be no change, resulting in effects that would be neutral and **not significant**.

Badgers

8.6.547 The likely effects of the operational phase on badgers to the north of the River Thames would be:

a. Direct mortality

b. Disturbance

c. Habitat fragmentation

8.6.548 **Direct mortality**: To the north of the River Thames, four green bridges have been proposed to reduce the likelihood of badgers crossing the Project over the carriageway, which would reduce the likelihood of collisions with traffic as shown in Figure 2.4: Environmental Masterplan (Application Document 6.2) and described in detail in Section 8.5. In addition, badger fencing would be installed to direct animals to these crossing locations as detailed in Section 8.5.

8.6.549 Any residual impacts on badger, which are locally important, would be irreversible permanent minor adverse and result in effects that are slight adverse and **not significant**.

8.6.550 **Disturbance:** During the operational phase of the Project it is feasible that light, noise and visual disturbance of badgers could occur. Any likely disturbance effects would be reduced by both noise and visual screening, as outlined in Chapter 12: Noise and Vibration. The operation phase lighting would be designed as part of the Project design and mitigation measures to preserve nocturnal character and habitats, and maintain dark corridors for wildlife (Design Principles (Application Document 7.5) Clause no. LST.02; LST.03), with assessment showing that within 30m the lux levels would fall to 0.5 lux (refer to Appendix 8.15 (Application Document 6.3)). Furthermore, badgers are highly tolerant of traffic disturbance, as evidenced by the presence of setts close to the M25 within the study area.

8.6.551 The inclusion of these Project design and mitigation measures would result in an irreversible permanent minor adverse level of impact on badgers, which are

of local importance, and effects that are considered to be slight adverse and **not significant**.

8.6.552 **Habitat fragmentation:** The operation of the Project would result in fragmentation of habitat to the north of the River Thames. The provision of four green bridges would ensure that commuting routes are available that allow badger to move within the wider landscape. In addition to the green bridges, where the route alignment is on a viaduct or overbridge, the free movement of badger would be provided under the Project as shown in Figure 2.4: Environmental Masterplan (Application Document 6.2) and described in detail in Section 8.5.

8.6.553 As such, any fragmentation impacts on badgers, which are locally important, would be irreversible permanent minor adverse and result in effects that would be slight adverse and **not significant**.

8.7 Cumulative effects

Intra-project effects

8.7.1 Cumulative effects of the Project can occur as a result of interrelationships between different environmental topics, which are referred to as 'intra-project effects'. For terrestrial biodiversity, interrelationships are identified with air quality (Chapter 5: Air Quality), cultural heritage (Chapter 6: Cultural Heritage), landscape and visual (Chapter 7: Landscape and Visual), marine biodiversity (Chapter 9: Marine Biodiversity), geology and soils (Chapter 10: Geology and Soils), noise and vibration (Chapter 12: Noise and Vibration), population and human health (Chapter 13: Population and Human Health) and road drainage and the water environment (Chapter 14: Road Drainage and the Water Environment). These are summarised below:

a. Air quality – degradation of sensitive habitats or species in close proximity to construction works or the ARN during both construction and operation, resulting from increased deposition of nitrogen or fine dust.

b. Cultural heritage – effects on heritage assets resulting from the loss of existing habitats that inform the value of heritage assets, and from the introduction of ecological mitigation causing physical impacts to heritage assets through its implementation and change to setting.

c. Landscape and visual – effects on woodland and habitats which are key features of designated and non-designated landscapes within the study area. Landscape planting proposed as a means of mitigation resulting in habitat losses and gains, with subsequent likely effects on species that occupy those habitats.

d. Marine – impacts to intertidal habitats and species of the River Thames which may alter the prey availability for birds.

e. Geology and soils – construction activities that alter soil characteristics could result in the degradation of some plants and habitats that have close

affinities to particular soil types, including some that form qualifying features of designated sites. A particular overlap relates to the construction impact on Low Street Pit LWS which is a potential Local Geological Site.

f. Hydrogeology – dewatering from tunnelling and other Project activities resulting in groundwater alteration that in turn could affect hydrologically-sensitive habitats, such as marshy grassland, and the species they support, including some that form qualifying features of designated sites.

g. Construction and operational noise and vibration – disturbance to species, including some that form qualifying features of designated sites.

h. Population and human health – disturbance to species and degradation of sites and habitats from increased visitor pressure.

i. Road drainage and the water environment – degradation of aquatic habitats and likely resultant effects on aquatic species that occupy those habitats.

8.7.2 The above interrelationships have been considered as part of the assessment reported in this chapter, and the relevant topic chapters identified above.

Inter-project effects

8.7.3 In addition to intra-project effects, cumulative impacts can also occur due to the Project in combination with other existing and/or approved developments. These are known as 'inter-project' effects and are considered separately in Chapter 16: Cumulative Effects Assessment.

8.8 Monitoring

8.8.1 An ECoW would be employed throughout the construction works to ensure all measures and method statements, including monitoring of important ecological features and biodiversity resources are adhered to (CoCP (Application Document 6.3, ES Appendix 2.2) REAC Ref. TB006)).

8.8.2 Habitats suitable for use by protected species, including nesting birds, would be subject to inspections by the ECoW prior to their removal, to confirm an absence of protected species (CoCP (Application Document 6.3, Appendix 2.2) REAC Ref. TB004). Where protected species are found to be present, suitable mitigation would be implemented to accord with any legislative requirements, which may include the implementation of works under a protected species mitigation licence. In such situations, monitoring of the population of, and the distribution within the Order Limits and the receptor sites of protected species during and post-construction would be in line with the requirements of the protected species mitigation licences (Appendices 8.16 to 8.20 (Application Document 6.3), CoCP (Application Document 6.3, Appendix 2.2) REAC Ref. TB014, TB015, TB016, TB017)).

8.8.3 Monitoring would also take place on the use of green bridges by wildlife, with a particular focus on the protected species these green bridges have been designed for, using techniques such as static bat detectors and camera traps.

8.8.4 Following construction, monitoring of newly created habitats, including those to address likely significant effects would be undertaken in accordance with the Landscape and Environmental Management Plan (LEMP). This would be approved by the Secretary of State in consultation with the relevant planning authority (and Natural England with respect to any land in the Shorne and Ashenbank Woods Site of Special Scientific Interest and/or the South Thames Estuary and Marshes Site of Special Scientific Interest). The LEMP would be prepared to be substantially in accordance with the outline LEMP (Application Document 6.7). The LEMP would outline the long-term commitments to aftercare, monitoring and maintenance activities relating to the landscaping and ecological features. UKHab surveys and condition assessments would be undertaken to inform progress towards target habitat and condition (Panks *et al.*, 2022a and 2022b).

8.9 Summary

8.9.1 The assessment of effects on terrestrial biodiversity considered the construction and operational phase impacts of the Project and the likely changes these would cause to biodiversity resources. Biodiversity resources that were assessed included designated sites, habitats and species. The assessments were undertaken in accordance with the Ecological Impact Assessment guidelines published by CIEEM and the DMRB (LA 108: Biodiversity).

8.9.2 Table 8.39 below outlines a summary of likely significant residual effects. This takes into consideration the agreed mitigation measures outlined above in Section 8.5.

8.9.3 Potential significant effects as a result of construction include habitat loss within statutory and non-statutory designated sites, including the loss of 7.36ha of ancient woodland, permanent loss of ancient and veteran trees and habitat loss and mortality of terrestrial invertebrate assemblages. During the operational phase of the Project, the significant effects are associated with the increase in nitrogen deposition on designated sites which has the potential to result in a degradation of habitat condition. Twenty-nine designated sites have been predicted to experience impacts which could lead to an effect on the site's integrity, and would be considered significant. These consist of four SSSI, 22 ancient woodlands, two LWS and one SINC.

8.9.4 Mitigation proposed is based on good practice guidance relevant to terrestrial biodiversity. This includes having the required Natural England licences, working practices and method statements in place to facilitate the implementation of mitigation, prior to construction works commencing. Proposed mitigation includes the translocation of protected species from the construction area to suitable retained or newly created habitats, and embedded design measures to reduce the magnitude of likely effects by, for example, providing safe crossing points for wildlife over or under the operational highway.

8.9.5 Compensatory measures are proposed to counteract significant effects on biodiversity that cannot be avoided or mitigated. These include habitat creation to compensate losses of ancient woodland and the degradation of habitats within designated sites as a result of nitrogen deposition, as well as the provision of barn owl nest boxes to compensate for the losses of barn owl individuals as a result of collision-related mortality during the operational phase

of the Project. Habitat creation proposals would provide long-term benefits to some ecological features, by providing extensive areas of new planting that would improve the connectivity between existing retained habitats and the wider network of designated sites.

8.9.6 In response to paragraph 5.23 of the NPSNN, which states '*The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests*', biodiversity metric calculations have been made to assess the biodiversity unit value of the baseline conditions, and that forecast to be generated by the Project. The current assessment is based on the preliminary Project design as of August 2022 and uses the Biodiversity Metric 3.1 Calculation Tool to determine whether the Project could result in a net gain in biodiversity units; full details of the methodology and calculations are provided in Appendix 8.21: Biodiversity Metric Calculations (Application Document 6.3).

Table 8.39 Terrestrial ecology impact summary table

Impact description	Importance	Level of impact	Effect	Significance
Construction				
South of the River Thames				
Permanent habitat loss at Shorne and Ashenbank Woods SSSI, including the loss of ancient woodland, totalling 5.85ha	National	Minor	Moderate adverse	**Significant**
Permanent habitat creation connecting Great Crabbles Wood SSSI and Shorne Woods	National	Minor	Slight beneficial	Not significant
No likely effects to other statutory designated sites	National	No change to negligible	Neutral to slight adverse	Not significant
Permanent habitat loss at Claylane Wood ASNW totalling 4.24ha	National	Major	Large adverse	**Significant**
Temporary habitat loss (habitat will be reinstated post construction phase) of Canal and Grazing Marsh Higham LWS of 4.17ha	County	Moderate	Slight adverse	Not significant
Effects of nitrogen deposition on irreplaceable habitat: Three ancient woodland sites Three veteran trees	National	No change to negligible	Neutral to slight adverse	Not significant
Effects of nitrogen deposition on non-statutory designated habitat: Straight Path Shaw LWS	County	Negligible	Neutral	Not significant
No likely significant effects to other non-statutory designated sites	County to National	No change	Neutral	Not significant
Loss of three veteran trees	National	Minor	Moderate adverse	**Significant**
Permanent loss of 7.03ha of semi-natural broadleaved woodland, 34.86ha of plantation woodland and 4.39ha of scrub habitats	County	Minor	Slight adverse	Not significant
Loss of parkland and scattered trees habitat	County	Minor	Slight adverse	Not significant
Loss of 20.07ha of semi-improved neutral grassland 2.73ha of calcareous grassland	County	Negligible	Slight adverse	Not significant

Impact description	Importance	Level of impact	Effect	Significance
Loss of 60.77ha of species-poor semi-improved grassland and 20.62ha of improved grassland	Local	Negligible	Neutral	Not significant
Permanent loss of six ponds	County	Minor	Slight adverse	Not significant
Permanent loss of 4.84km of hedgerow habitat	County	Minor	Slight adverse	Not significant
Permanent loss of 4.43ha of open mosaic habitat	County	Negligible	Slight adverse	Not significant
Net gain of 220.7ha of semi-natural habitats to improve connectivity of retained habitats and compensate for predicted losses of habitats from the construction of the Project	County	Minor	Slight beneficial	Not significant
Temporary loss of habitat used by terrestrial invertebrates and mortality of terrestrial invertebrate assemblages	Regional to national	Minor	Slight adverse	Not significant
Fragmentation of habitats used by bats, particularly for commuting	County	Minor	Slight adverse	Not significant
Habitat loss and disturbance to GCN, reptiles, birds, bats, dormice, water vole	County to regional	Negligible to minor	Slight adverse	Not significant
Habitat loss, fragmentation and degradation of habitats used by freshwater species, otters and badgers	Local to regional	No change to negligible	Neutral to slight adverse	Not significant
Creation of additional habitats suitable for use by reptiles and dormice, including the landscape planting, habitat compensation areas and green bridges	County	Major	Slight beneficial	Not significant
Mortality of amphibians, reptiles, birds, bats, water voles, otters and badgers	Local to regional	No change to negligible	Neutral	Not significant
River Thames				
No predicted significant effects to any important ecological features or biodiversity resources, including the Thames Estuary and Marshes SPA and Ramsar site	Local to international	Negligible	Slight adverse	Not significant

Impact description	Importance	Level of impact	Effect	Significance
North of the River Thames				
No predicted effects to statutory designated sites	National	No change	Neutral	Not significant
Habitat loss at Low Street Pit LWS totalling 3.52ha	County	Major	Moderate adverse	**Significant**
Habitat loss at Tilbury Marshes LWS totalling 0.83ha	County	Minor	Slight adverse	Not significant
Habitat loss at Tilbury Centre LWS totalling 0.03ha	County	Negligible	Slight adverse	Not significant
Habitat loss at Rainbow Shaw LWS totalling 1.20ha	National	Major	Large adverse	**Significant**
Habitat loss at Blackshots Nature Area LWS totalling 12.30ha	County	Major	Moderate adverse	**Significant**
Permanent habitat loss at the Wilderness ASNW totalling 0.44ha	National	Major	Large adverse	**Significant**
Habitat loss at Codham Hall Wood LWS and ASNW totalling 0.15ha	National	Minor	Moderate adverse	**Significant**
Habitat loss within Codham Hall Wood West SINC and ancient woodland west of M25 junction 29 totalling 0.15ha	National	Minor	Moderate adverse	**Significant**
Habitat loss at Ockendon Railsides SINC totalling 0.67ha (no ancient woodland loss)	County	Negligible	Slight adverse	Not significant
Habitat loss at Thames Chase Forest Centre SINC totalling 13.3ha (no ancient woodland loss)	County	Moderate	Slight adverse	Not significant
Habitat loss at North Ockendon Pit SINC totalling 1.39ha	County	Negligible	Slight adverse	Not significant
Habitat loss at Franks Wood and Cranham Brickfields SINC totalling 0.48ha	County	Negligible	Slight adverse	Not significant
Habitat loss at Hobbs Hole Wood LWS totalling 0.35ha	County	Minor	Slight adverse	Not significant
Habitat loss at Mucking Heath LWS totalling 2.26ha	County	Minor	Slight adverse	Not significant
Habitat loss at Fields South of Cranham Marsh SINC totalling 0.01ha	County	Negligible	Neutral	Not significant

Impact description	Importance	Level of impact	Effect	Significance
Habitat loss at Linford Pit LWS totalling 0.5ha	County	Negligible	Slight adverse	Not significant
Effects of nitrogen deposition on irreplaceable habitat: Six ancient woodland sites	National	Negligible	Slight adverse	Not significant
Effects of nitrogen deposition on non-statutory designated habitat: Seven LWS Three SINC	County	No change to negligible	Neutral to slight adverse	Not significant
No predicted significant effects to other non-statutory designated sites	County to national	No change	Neutral	Not significant
Loss of three veteran trees	National	Minor	Moderate adverse	**Significant**
Loss of 9.9ha of semi-natural broadleaved and mixed woodland	County	Minor	Slight adverse	Not significant
Permanent loss of 64.92ha of plantation woodland and 24.03ha of scrub habitat	Local	Minor	Slight adverse	Not significant
Loss of 1.14ha of unimproved and semi-improved acid grassland and 60.48ha of semi-improved neutral grassland	County	Minor	Slight adverse	Not significant
Loss of 41.83ha of improved grassland 0.05ha of marshy grassland and 68.35ha of species-poor semi-improved grassland	Local	Minor	Slight adverse	Not significant
Loss of 1.21ha of swamp and marginal vegetation; loss of riverine and stream habitat associated with the culverting of watercourses; loss of 31 ponds; loss of 37.47km of hedgerow habitat; permanent loss of 66.91ha of open mosaic habitat	County	Minor	Slight adverse	Not significant
Net gain of 504.53ha of semi-natural habitats to improve connectivity of retained habitats and compensate the predicted losses of habitats from the construction of the Project	County	Minor	Slight beneficial	Not significant
Loss of terricolous lichen habitat	County	Minor	Slight adverse	Not significant

Impact description	Importance	Level of impact	Effect	Significance
Loss of habitat used by terrestrial invertebrates and mortality of terrestrial invertebrate assemblages	National	Moderate	Moderate adverse	**Significant**
Habitat loss, fragmentation and degradation of habitats used by, and disturbance to freshwater species, amphibians, reptiles, bird assemblages, barn owls, bats, water voles, otters and badgers	Local to county	Negligible to minor	Slight adverse	Not significant
Mortality of freshwater species, amphibians, reptiles, bird assemblages, bats, water voles, otters and badgers	Local to regional	No change to negligible	Neutral	Not significant
Creation of additional habitats suitable for use by reptiles, including the landscape planting, habitat compensation sites and green bridges	County	Minor	Slight beneficial	Not significant
Loss of three barn owl breeding sites. Compensation would be provided through the provision of alternative nesting sites, meaning the population of barn owls will be maintained.	County	Minor	Slight adverse	Not significant
Operation				
South of the River Thames				
Effects of nitrogen deposition on statutory designated habitats: Cobham Woods SSSI; Halling to Trottiscliffe Escarpment SSSI; Shorne and Ashenbank Woods SSSI; Wouldham to Detling Escarpment SSSI.	National	Moderate to major	Moderate to large adverse	**Significant**
Effects of nitrogen deposition on statutory designated habitats: Great Crabbles Wood SSSI; Titsey Woods SSSI; Westerham Wood SSSI	National	Negligible	Slight	Not significant
Effects of nitrogen deposition on statutory designated habitats: Rede Common LNR	County	Moderate	Slight adverse	Not significant
Effects of nitrogen deposition on irreplaceable habitat: Nineteen ancient woodland sites (see Table 8.37).	National	Moderate to major	Moderate to very large adverse	**Significant**

Impact description	Importance	Level of impact	Effect	Significance
Effects of nitrogen deposition on irreplaceable habitat: Fifteen ancient woodland sites. Eighteen veteran trees	National	Negligible to minor	Slight adverse	Not significant
Effects of nitrogen deposition on non-statutory designated habitats: Bridge Woods, Burham LWS	County	Major	Moderate adverse	**Significant**
Effects of nitrogen deposition on non-statutory designated habitats: Twelve LWS One SINC	County	Negligible to moderate	Neutral to slight adverse	Not significant
Mortality of birds, bats and badgers through collision with motor vehicles and disturbance to birds, bats and badgers	Local to county	Minor	Slight adverse	Not significant
Fragmentation of habitats used by bats and badgers	County	Minor	Slight adverse	Not significant
No predicted impacts to any other biodiversity resources	Local to international	No change	Neutral	Not significant
River Thames				
No predicted impacts to any important ecological features or biodiversity resources	Local to international	No change	Neutral	Not significant
North of the River Thames				
Effects of nitrogen deposition on statutory designated habitats: Epping Forest SAC; Epping Forest SSSI; Langdon Ridge SSSI	National to international	No change to negligible	Neutral to slight adverse	Not significant
Effects of nitrogen deposition on irreplaceable habitats: Three ancient woodland sites (see Table 8.38).	National	Moderate to major	Moderate to large adverse	**Significant**
Effects of nitrogen deposition on irreplaceable habitats: Six ancient woodland sites One veteran tree	National	Negligible to minor	Slight adverse	Not significant
Effects of nitrogen deposition on non-statutory designated habitats: Codham Hall Woods LWS Ockendon Railsides SINC	County	Major	Moderate adverse	**Significant**

Impact description	Importance	Level of impact	Effect	Significance
Effects of nitrogen deposition on non-statutory designated habitats: Sixteen LWS Seventeen SINC	County	No change to major	Neutral to slight adverse	Not significant
Degradation of aquatic habitats of importance to macro-invertebrates	County	Negligible	Slight adverse	Not significant
Fragmentation of GCN, bat, badger and water vole habitat	County to regional	Negligible to minor	Slight adverse	Not significant
Mortality of barn owls and other birds, bats and badgers through collision with motor vehicles and disturbance to birds, bats and badgers	Local to Regional	Minor	Slight adverse	Not significant
No predicted impacts to any other important ecological features or biodiversity resources	Local to national	Minor	Neutral	Not significant

References

Anderson, P. (2003). Habitat Translocation - A Best Practice Guide: C600. Construction Industry Research & Information Association (CIRIA).

Beebee, T. and Griffiths, R. (2000). Amphibians and Reptiles. A Natural History of the British Herpetofauna. London: HarperCollins

BS EN 12464-2:2014 (2014) Light and lighting. Lighting of work places. Outdoor work places. London: British Standards Institution

Chadd, R. and Extence, C. (2004). The conservation of freshwater macroinvertebrate populations: a community-based classification scheme. Aquatic Conservation: Marine and Freshwater Ecosystems. 14: pp. 597-624.

Chartered Institute of Ecology and Environmental Management (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal. 2nd edition. Winchester: CIEEM

Colin Plant Associates (2008). Tilbury Power Station Essex Invertebrate Survey Report. Appendix 10.J

Colin Plant Associates (2016). Land Adjacent to Tilbury Power Station Essex Invertebrate Survey Report (November 2016). Appendix 10.K

Conservation of Habitats and Species Regulations 2017 (SI 2017/1012).

The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019. United Kingdom. Accessed June 2021. legislation.gov.uk

Crawford, A. (2010). Fifth Otter Report. Environment Agency

Christensen, M., Fjederholt, E.T., Baagøe, H.J. and Elmeros, M. (2016) Hop-overs and their effects on flight heights and patterns of commuting bats – a field experiment. SafeBatPaths Technical Report. Conference of European Directors of Roads (CEDR), Brussels.

Dean, M., Strachan, R., Gow, D and Andrews, R, (2016). The Water Vole Mitigation Handbook. London: The Mammal Society

Department of Energy and Climate Change (2011a). Overarching National Policy Statement for Energy (EN-1). Accessed November 2021. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf.

Department of Energy and Climate Change (2011b). National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4). Accessed November 2021. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/37049/1941-nps-gas-supply-oil-en4.pdf.

Department of Energy and Climate Change (2011c). National Policy Statement for Electricity Networks Infrastructure (EN-5). Accessed November 2021. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/37050/1942-national-policy-statement-electricity-networks.pdf.

Department for Environment, Food and Rural Affairs (2011). Biodiversity 2020: A strategy for England's wildlife and ecosystem services. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69446/pb13583-biodiversity-strategy-2020-111111.pdf

Department for Environment, Food and Rural Affairs (2016). UK Biodiversity Indicators 2015. https://data.jncc.gov.uk/data/e3cbd4a9-e3d5-496f-8761-947bfb888967/UKBI-2015-v5.pdf

Department for Transport (2014). National Policy Statement for National Networks. Accessed April 2020. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf

D.K. Symes Associates (2017). Continued re-profiling of the site to 9 metres AOD using inert reclamation material imported by river, in place of PFA from the adjacent now redundant Power Station: Initial Restoration Plan.

D.K. Symes Associates (2019). Application for the variation of conditions no 9 (Timescales) [to Extend time period for completion from 31.12.2019 to 31.12.2032] and no 11 (Plans) [To alter phasing of restoration] of planning permission ref 17/00412/FUL (Continued re-profiling of the site to 9 metres AOD using inert reclamation material imported by river, in place of Pulverised Fuel Ash from the adjacent now redundant Power Station) Land Adjacent Tilbury Power Station Fort Road Tilbury Essex: Aspirational Masterplan.

Du Feu (1993). BTO Guide 23, Nestboxes, BTO

Eaton, M., Aebischer, N., Brown, A., Hearn, D., Stroud, D. and Gregory, R. (2015). Birds of Conservation Concern 4: the population status of birds in the UK, Channel Island and Isle of Man. British Birds, 108: pp. 708-746.

English Heritage (2014). Essex Grazing Marsh Project. https://historicengland.org.uk/research/results/reports/6971/EssexGrazingMarshesProject

English Nature (2001). Great Crested Newt Mitigation Guidelines. English Nature, Peterborough. https://www.merthyr.gov.uk/media/1241/great-crested-newts-mitigation-guidlines.pdf

Essex Biodiversity Project (2011). Essex Biodiversity Action Plan (9). http://www.essexbiodiversity.org.uk/

Essex County Council, Buglife, University of East London and Natural England (2013). Thames Terrace Invertebrates: A Masterplan for Landscape-scale Conservation in the Greater Thames Marshes. http://greaterthamesmarshes.com/wp-content/uploads/2012/11/NIA-TTI-Masterplan-May-2013.pdf

Essex Field Club (EFC) (2022). Biological records data request; issued 01 January 2022. http://www.essexfieldclub.org.uk/

Essex Wildlife Trust Biological Records Centre (EWTBRC) (2020). Biological records data request; issued 30 March 2020. http://www.essexwtrecords.org.uk/

Froglife (1999). Reptile survey: an introduction to planning, conducting and interpreting surveys for snake and lizard conservation. Froglife Advice Sheet 10. Halesworth: Froglife

Greenspace Information for Greater London (GiGL) (2022). Biological records data request; issued 01 January 2022. https://www.gigl.org.uk/

Highways England (2017). Lower Thames Crossing, Environmental Impact Assessment – Scoping Report (Ref: CASCADE-CJV-GEN-GEN-REP-ENV-00001).

Highways England (2018). Preliminary Environmental Information Report – Statutory Consultation (Ref: HE540039-CJV-GEN-GEN-REP-ENV-00015).

Highways England (2020a). Design Manual for Roads and Bridges: LA 108 Biodiversity. Accessed March 2020 http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/LA%20108%20Biodiversity-web.pdf

Highways England (2020b). Design Manual for Roads and Bridges: LA 105 Air Quality. Accessed March 2020 https://standardsforhighways.co.uk/dmrb/search?q=LA%20105&pageNumber=1

Highways England (2020c). Design Manual for Roads and Bridges (DMRB) LA 111: Noise and Vibration V2. Accessed July 2020. https://www.standardsforhighways.co.uk/dmrb/.

Highways England (2020d). Design Manual for Roads and Bridges (DMRB) LA 113 Road Drainage and the Water Environment. Accessed March 2020 https://www.standardsforhighways.co.uk/dmrb/.

Highways England (2020e). Design Manual for Roads and Bridges (DMRB) LD 118 Biodiversity Design. Accessed July 2021 https://www.standardsforhighways.co.uk/dmrb/.

Highways England (2020f). Design Manual for Roads and Bridges (DMRB) LA 115 Habitats Regulations assessment. Accessed July 2021 https://www.standardsforhighways.co.uk/dmrb/.

Holling and the Rare Breeding Bird Panel (2018). Rare breeding birds in the UK in 2016. Accessed October 2019 http://www.rbbp.org.uk/downloads/rbbp-report-2016.pdf

Institute of Fisheries Management (undated). Fish Pass Manual

Institute of Lighting Professionals (2020) Guidance Notes for the Reduction of Obtrusive Light GN01/20

Juskaitis, R. (2008). The Common Dormouse *Muscardinus avellanarius*: Ecology, Population Structure and Dynamics. Vilnius: Institute of Ecology of Vilnius University

Joint Nature Conservation Committee (2004). Ramsar Information Sheet Thames Estuary and Marshes. 3rd edition. Accessed October 2019. https://rsis.ramsar.org/RISapp/files/RISrep/GB1025RISformer2000_EN.pdf

Kent Biodiversity Action Plan Steering Group (1997). The Kent Biodiversity Action Plan. https://www.medway.gov.uk/download/downloads/id/279/kent_biodiversity_action_plan.pdf

Kent Ornithological Society (2019). Kent Bird Report

Kent Reptile and Amphibian Group (2019). *Great Crested Newt Triturus cristatus*. Accessed December 2019. https://kentarg.org/amphibians/great-crested-newt/

Kent and Medway Biological Records Centre (KMBRC) (2022). Biological records data request; issued 01 January 2022. https://www.kmbrc.org.uk

Kent Biodiversity Partnership (2009). Kent Biodiversity Action Plan. http://kentbap.org.uk/habitats-and-species/priority-habitat / Accessed June 2020.

Landscape Institute (2015). Green Bridges Technical Guidance Note. Access May 2020 https://www.landscapeinstitute.org/publication/green-bridges/

Liley, D. (2011). What do we know about the birds and habitats of the North Kent Marshes? Baseline data collation and analysis. Natural England Commissioned Reports, Number 082

Masters-Williams, H. *et al.*, 2001. *Control of Water Pollution from Construction Sites (C532).,* Londoon: Construction Industry Research and Information Association (CIRIA)

Ministry of Housing, Communities and Local Government (2021) National Planning Policy Framework https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1004408/NPPF_JULY_2021.pdf

Morecroft, M. and Speakman, L. (2015). Biodiversity Climate Change Impacts Summary Report, Living With Environmental Change.

Natural England (n.d.). Multi-Agency Geographic Information for the Countryside (MAGIC). Accessed March 2020. http://magic.defra.gov.uk/

Natural England (1984). Cobham Woods SSSI Citation. Accessed October 2018. https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1003501.pdf

Natural England (2013). The Mosaic Approach: Managing Habitats for Species. Accessed April 2020. (B2020-009). http://publications.naturalengland.org.uk/publication/6415972705501184

Natural England (2015). Green Bridges – A Literature Review. http://publications.naturalengland.org.uk/publication/6312886965108736

Natural Environment and Rural Communities Act 2006 (c.16)

Panks, D., White, N., Newsome, A., Nash, M., Potter, J., Heydon, M., Mayhew, E., Alvarez, M., Russell, T., Cashon, C., Goddard, F., Scott, S. J., Heaver, M., Scott, S. H., Treweek, J., Butcher, B., and Stone, D. (2022a). The Biodiversity Metric 3.1: Auditing and accounting for biodiversity. Technical Supplement. York: Natural England.

Panks, D., White, N., Newsome, A., Nash, M., Potter, J., Heydon, M., Mayhew, E., Alvarez, M., Russell, T., Cashon, C., Goddard, F., Scott, S. J., Heaver, M., Scott, S. H., Treweek, J., Butcher, B., and Stone, D. (2022b). The Biodiversity Metric 3.1: Auditing and accounting for biodiversity. User Guide. York: Natural England.

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

Shawyer, C. and Dixon, N. (1999). Impact of Roads on Barn Owl *Tyto alba* Populations. London: Highways Agency

Strachan R., Moorhouse T. and Gelling M. (2011). Water Vole Conservation Handbook. Third Edition. Wildlife Conservation Research Unit

Telfer (2017). Invertebrate Survey of Tilbury2

The Eels (England and Wales) Regulations 2009 (SI 2009/3344).

Toms, M., Crick, H. and Shawyer, C. (2001). The status of breeding Barn Owls *Tyto alba* in the United Kingdom 1995-97. Bird Study, 48: pp. 23-27

Wade, M., Booy, O. and White, V. (2008). Invasive species management for infrastructure managers and the construction industry. London: CIRIA.

Webb, J., Heaver, D., Lott, D., Dean, H.J., van Breda, J., Curson, J., Harvey, M., Gurney, M., Roy, D.B., van Breda, A., Drake, M., Alexander, K.N.A. and Foster, G. (2017). Pantheon – database version 3.7.4. [Online]. Accessed October 2017. http://www.brc.ac.uk/pantheon/

WYG (2018) Tilbury Power Station: Ecology Survey and Mitigation Plan (December 2015). Document Ref: A088550 Appendix 10.A. WYG, London.

ZSL (2018). The Thames European Eel Project Report. https://www.zsl.org/sites/default/files/media/2018-12/ZSL%202018%20eel%20report_FINAL.pdf

If you need help accessing this or any other National Highways information, please call **0300 123 5000** and we will help you.

If you have any enquiries about this publication email **info@nationalhighways.co.uk**
or call **0300 123 5000***.

*Calls to 03 numbers cost no more than a national rate call to an 01 or 02 number and must count towards any inclusive minutes in the same way as 01 and 02 calls.

These rules apply to calls from any type of line including mobile, BT, other fixed line or payphone. Calls may be recorded or monitored.

Printed on paper from well-managed forests and other controlled sources when issued directly by National Highways.

Registered office Bridge House, 1 Walnut Tree Close, Guildford GU1 4LZ

National Highways Company Limited registered in England and Wales number 09346363