Norwich Western Link

Pre-Application Consultation Report

Appendix 4: Environmental Information Document July 2022

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Contents

1 Introduction

1.1.1 This Environmental Information Document (EID) is one of the documents produced in connection with the non-statutory Pre-Planning Application Public Consultation on the proposals for the NWL.

1.1.2 The EID provides further detail on proposals for the NWL in the overarching Pre-Planning Application Public Consultation brochure. The EID provides a summary of the current understanding of the local environmental conditions (referred to as 'environmental baseline' throughout this report), potential impacts, and associated mitigation and enhancement proposals at the time of consultation.

1.1.3 The purpose of this EID is to give people responding to the consultation a preliminary understanding of the environmental baseline and likely environmental effects of the NWL in advance of the project's Environmental Statement (ES) being produced.

1.1.4 The ES will summarise the findings of the environmental impact assessment (EIA) of the NWL to inform decision makers regarding the environmental implications of the NWL.

1.1.5 This EID is not intended to replace the ES or any other form of assessment produced in support of the planning application for the NWL. The ES will be published alongside the planning application.

1.1.6 We have included a summary of key information shown in this document in an accessible format. However, some users may not be able to access all technical details. If you require this document in a more accessible format please contact norwichwesternlink@norfolk.gov.uk

Norfolk County Council

NORWICH WESTERN LINK

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

1.1.1. The Norwich Western Link (NWL) is a proposed 3.9-mile dual carriageway road to connect the A1270 Broadland Northway to the A47. The NWL would complete a fully dualled orbital route around the city in combination with the planned dualling of the A47 between North Tuddenham and Easton, due to open in 2026. National Highways proposes to realign and dual the A47 between Easton and North Tuddenham, with construction of a grade separated dumbbell roundabout junction at Wood Lane, Honingham. The NWL would connect via the northern roundabout with an additional arm added at the north-east edge of the junction.

1.1.2. The NWL will cross the River Wensum and floodplain by viaduct. Additional structures are proposed to cross Ringland Lane and to provide habitat connectivity. The NWL will include ancillary works, including stopping up of some minor roads that currently cross the proposed route and the provision of environmental mitigation measures.

1.1.3. The 'NWL Boundary' is used throughout this document and refers to the extent of land required for the construction of the Scheme. The term 'NWL' is also referred to and relates to the alignment of the NWL itself.

1.2 PURPOSE OF REPORT

1.2.1. This Environmental Information Document (EID) is one of the documents produced in connection with the non-statutory Pre-Planning Application Public Consultation on the proposals for the NWL. The EID provides further detail on proposals for the NWL in the overarching Pre-Planning Application Public Consultation brochure. The EID provides a summary of the current understanding of the local environmental conditions (referred to as 'environmental baseline' throughout this report), potential impacts, and associated mitigation and enhancement proposals at the time of consultation.

1.2.2. The purpose of this EID is to give people responding to the consultation a preliminary understanding of the environmental baseline and likely environmental effects of the NWL in advance of the project's Environmental Statement (ES) being produced.

1.2.3. The ES will summarise the findings of the environmental impact assessment (EIA) of the NWL to inform decision makers regarding the environmental implications of the NWL.

1.2.4. This EID is not intended to replace the ES or any other form of assessment produced in support of the planning application for the NWL. The ES will be published alongside the planning application.

1.2.5. Key elements of the environmental baseline are included on environmental constraints figures in **Appendix A** and include: **Figure 1 – General Environmental Constraints, Figure 2 – Source Protection Zones, Figure 3 – Ecology Designated Sites and Constraints, Figure 4 – International and National Designated Sites within Defined Study Areas from the NWL and Figure 5 – Ecological Constraints, Habitats and Protected Species**.

1.2.6. The EID is based on the most recent design (including the alignment refinement north of Ringland Lane) and summarises the current understanding of the NWL. Environmental information is derived from the Outline Business Case (OBC), Environmental Impact Assessment Scoping Report and current work towards the baseline of the ES. The ES and some surveys are still being undertaken and the design will continue to develop, therefore the document purely provides the information known to date and does not predict outcomes of the environmental assessment to follow.

2 AIR QUALITY

2.1 BASELINE

AIR QUALITY IN RELATION TO HUMAN HEALTH

2.1.1. Local and national government have legal duties to routinely monitor and manage air quality. It is known that air quality across much of Norfolk is considered good, where concentrations of all air pollutants meet legal standards for the protection of public health. These standards are set as objectives, targets, and limit values. Local authorities are responsible for Local Air Quality Management (LAQM) to meet the objectives. National government is responsible for meeting target and limit values at national level, with LAQM playing a key role in this.

2.1.2. The greatest challenges in achieving air quality standards are the impacts of road traffic emissions on concentrations of nitrogen dioxide and particulate matter - including PM_{10} (coarse particulates) and $PM_{2.5}$ (fine particulates) - in the surrounding outdoor (ambient) air. Concentrations of these pollutants tend to be greatest at the road edge and rapidly decline to relatively low (background) levels with distance (generally within 200 metres) from the roadside. Increased use of vehicles with ultra-low emissions and zero emissions vehicles will reduce road traffic contributions to ambient concentrations of nitrogen dioxide and particulate matter substantially in coming years.

2.1.3. At local level, where there is exceedance of one or more standard (where an objective is not being achieved) the relevant local authority has to declare an Air Quality Management Area (AQMA) and implement an Air Quality Action Plan for improvement. Norfolk currently has four AQMAs, for exceeding annual mean concentrations of nitrogen dioxide:

- The Railway Road AQMA;
- Gaywood Clock AQMA;
- Breckland District Council AQMA number 2; and
- Central Norwich AQMA.

2.1.4. The NWL air quality study area will include roads where the changes in traffic and/or road alignment could substantially influence local air quality. These roads will be defined using standard air quality assessment scoping criteria[1] which are applied to the traffic data – as derived from the Norwich Area Transport Strategy Model (which forecasts traffic movements with and without the NWL, and NWL design drawings. Roads with predicted change in annual average daily traffic flow of all vehicles of 1,000 or more and/or heavy-duty vehicles of 200 or more, and/or shift in carriageway alignment of 5 metres or more will be scoped in; those not meeting any of these criteria will be scoped out. The roads scoped in will form the 'affected road network'. The air quality study area will be limited to 200 metres from the affected road network, since any changes beyond this distance will be imperceptible. The final study area will be confirmed in the ES

[1] Design Manual for Roads and Bridges (DMRB) LA 105 Air Quality

2.1.5. Within the NWL air quality study area, the current baseline evidence from local authorities, Defra and monitoring of roadside nitrogen dioxide concentrations undertaken by WSP between September 2019 and March 2020, shows that legal air quality standards for the protection of public health are very likely to be met. The available monitoring data is deemed sufficient to support the air quality assessment in the ES.

AIR QUALITY IN RELATION TO SENSITIVE ECOSYSTEMS

2.1.6. Additionally, there are standards for the protection of sensitive ecological habitats.

2.1.7. Designated ecological sites within the air quality study area that are sensitive to changes in pollutant levels include Special Area of Conservation (SAC), Site of Special Scientific Interest (SSSI), Ramsar Sites, Special Protection Areas (SPAs) and Ancient Woodland.

2.1.8. With regard to current baseline conditions at these designated ecological sites, information published by the Joint Nature Conservation Committee on concentrations of nitrogen oxides and ammonia, deposition rates of nitrogen and acid gases show critical levels and loads are likely to be exceeded in most cases. Critical levels have been defined for the protection of vegetation concentrations of nitrogen oxides and ammonia. A critical load relates to the quantity of pollution below which harm is not likely to occur.

2.2 POTENTIAL IMPACTS

CONSTRUCTION PHASE

2.2.1. A qualitative construction dust risk assessment will be undertaken as part of the ES assessment, following guidance[2], to determine potential impacts at human and ecological receptors within 200m of the NWL. Dust from the works may result in increased levels of deposition on exposed surfaces. Abnormally high levels, without mitigation, could potentially impact human receptors causing disruption to normal activities, and adversely affecting sensitive ecological receptors.

OPERATIONAL PHASE

2.2.2. A detailed assessment, to be reported in the ES, will determine the air quality impacts for the NWL once it becomes operational.

2.2.3. To assess the impacts on human receptors where there is relevant public exposure, ambient concentrations of nitrogen dioxide) and particulate matter will be predicted at locations likely to experience the highest concentrations and greatest changes. The predicted concentrations will be compared to the relevant air quality standards and the differences for scenarios with and without the NWL will be determined. Locations experiencing lower traffic levels as a result of the Proposed Scheme are likely to experience some improvement in air quality; conversely, locations where traffic levels increase are likely to experience some worsening. The significance of effect in terms of these impacts will be determined in accordance with Design Manual for Roads and Bridges (DMRB) LA 105 guidance.

2.2.4. For ecological receptors, concentrations of nitrogen oxides and ammonia will be predicted with the nitrogen and acid deposition rates and compared against the relevant critical levels and loads. The

[2] Design Manual for Roads and Bridges (DMRB) LA 105 Air Quality

predicted impacts will be examined by the ecology specialist to determine the effect and will be considered in the Habitat Regulations Assessment (HRA) (See Section 6).

2.3 POTENTIAL MITIGATION MEASURES AND ENHANCEMENT OPPORTUNITIES

2.3.1. The Principal Contractor will be required to prevent and control emissions during the construction period using best practice measures, in accordance with the Outline Construction Environmental Management Plan (OCEMP) that will be submitted with the Planning Application. The OCEMP will be adopted by the contractor and form the basis of the detailed CEMP used to manage the works on site.

2.3.2. The OCEMP will be based on established good management practice, utilising outcomes of the environmental assessments undertaken as part of the planning application, its purpose will be to prescribe the overarching mitigation principles to be applied and key responsibilities for the construction management of the Proposed Development. The OCEMP will detail how construction impacts will be managed, particularly on neighbouring properties, sensitive uses, biodiversity, and the highway network

2.3.3. Measures will be confirmed in the ES. Typical measures include:

- Earthworks operations shall be organised to avoid double handling of potentially dusty materials;
- Maximum-speed-limits on surfaced and unsurfaced haul roads and work areas are to be signposted and enforced. If long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the acceptance of the project environmental manager and with the agreement of the local authority, where appropriate;
- Surfaces of unpaved haul roads and site areas routinely crossed by vehicles to be regularly compacted and maintained in a damp condition to minimise risk of mobilising dust;
- All loads of potentially dusty materials are to be covered/contained before transport on the public highway to prevent the escape of materials;
- Prior to leaving the site, all vehicles are to be inspected and, if necessary, cleaned to prevent transporting mud and debris onto the public highway;
- Vehicle cleaning facilities to be provided before the site exit with appropriate drainage arrangements to prevent pollution of surface and ground waters; and
- Water-assisted dust sweepers to be used to remove any accumulations of mud and debris from hard standing areas within the site and public highway.

2.3.4. Specific mitigation of operational phase air quality impacts will only be required if significant adverse effects are predicted by the ES assessment.

3 NOISE AND VIBRATION

3.1 BASELINE

ASSESSMENT STUDY AREAS

3.1.1. The study areas for the construction noise and vibration and operational noise assessments will be confirmed in the ES. The following sections indicate how noise and vibration study areas will be determined, in line with current guidance.

Construction Noise and Vibration

3.1.2. In line with the DMRB LA 111 guidance[3] the following study areas will be adopted for the construction phase:

- Construction noise – 300m from any construction activity;
- Construction vibration – 100m from any vibration generating construction activity; and
- Construction traffic on the wider road network – 50m from the kerb line of public roads with the potential to experience at least a 1 decibel (dB) change in noise level, to be identified through the traffic modelling undertaken to support the planning application.

Operational Noise

3.1.3. In line with DMRB LA 111[3] guidance, the operational noise study area will encompass an area within 600m of the NWL and include an area within 50m of other road links (outside of the 600m area) with the potential to experience a noise level change of more than 1.0 dB in the short-term as a result of changes in traffic flows due to the NWL.

BASELINE NOISE CLIMATE

3.1.4. At the northern end of the NWL, the noise climate is dominated by road traffic noise from Fakenham Road (A1067). Moving south, some contribution to the noise climate comes from road traffic on the nearby local roads although the background noise levels are generally low with road traffic noise from the A47 dominating the southern end of the NWL.

Noise Sensitive Receptors

3.1.5. Based on current information, within 600m of the NWL, there are approximately 50 residential receptors considered sensitive to noise which are predominantly isolated properties. No other sensitive receptors are within 600m of the NWL but this will be reviewed at the ES stage.

3.1.6. Human receptors within designated areas such as the River Wensum SSSI and SAC will also be considered in the noise assessment. Ecological receptors sensitive to changes in noise will be considered in the Biodiversity chapter of the ES and the Habitat Regulations Assessment (HRA).

3.1.7. Noise and vibration impacts to heritage assets will be considered in the **Cultural Heritage** chapter of the ES.

[3] Design Manual for Roads and Bridges LA 111 Noise and Vibration, Revision 2, May 2020

3.1.8. There are no Noise Important Areas (NIAs) within 600 metres of the NWL. NIAs are areas identified as experiencing the highest 1% of noise levels in residential areas, based on strategic noise mapping undertaken by the Department for the Environment and Rural Affairs.

Baseline Noise Monitoring

3.1.9. Baseline noise surveys have been undertaken in 2021 (during school term time) at selected locations within the vicinity of the NWL and the results will be included in the noise assessment for the NWL at the ES stage. Baseline noise monitoring (a mix of short-term and long-term measurements) will be used to inform the construction and operational noise assessments of the NWL.

A47 NATIONAL HIGHWAYS DUALLING SCHEME

3.1.10. The A47 (managed by National Highways) is proposed to be dualled and slightly re-routed at the southern end of the NWL (not within the scope of the NWL). The assessment of the NWL in the ES will assume the A47 is dualled both 'with' and 'without' NWL traffic scenarios, therefore, noise impacts from the A47 dualling and re-routing will not be considered in this assessment.

3.2 POTENTIAL IMPACTS

CONSTRUCTION

3.2.1. Any construction stage impacts will be temporary and with receptors impacted over discrete periods of time.

Construction Noise

3.2.2. Significant construction noise impacts may occur where construction activities are undertaken within 300m of a sensitive receptor, and there is likely to be a number of residential receptors located within 300m of the proposed works which could be adversely impacted during the construction stage.

3.2.3. The construction activities most likely to cause adverse impacts are activities of longest duration. Earthworks and bridge and viaduct construction are the activities with the greatest potential to cause adverse impacts. Where adverse construction noise impacts are predicted, mitigation measures will be employed to minimise noise levels as far as reasonably possible. The likely construction mitigation measures are assessed below.

Construction Vibration

3.2.4. There is the potential for significant construction vibration where vibration-generating construction activities are undertaken within 100m of a sensitive receptor.

3.2.5. Where piling is required, (for bridge and viaduct construction), vibration impacts may extend outside of the 100m area. Where adverse construction vibration impacts are predicted, mitigation measures will be explored to minimise impacts.

OPERATION

3.2.6. Noise level changes as a result of the operation of the NWL are anticipated at nearby receptors. The pattern of noise level changes associated with the NWL are likely to be beneficial impacts at receptors on or close to existing roads experiencing a reduction in traffic and adverse impacts at receptors close to the alignment of the NWL, from the introduction of a new noise source.

3.2.7. In line with guidance[4], as part of the ES assessment detailed noise modelling will be undertaken within an area 600m from the kerb alignments of the NWL. This assessment will consider predicted noise level changes as a result of the NWL, and absolute predicted noise levels, as well as other relevant contextual factors.

3.3 POTENTIAL MITIGATION MEASURES AND ENHANCEMENT OPPORTUNITIES

CONSTRUCTION

3.3.1. Once detailed construction noise and vibration assessments have been undertaken as part of the Noise and Vibration ES Chapter, and likely significant impacts identified, appropriate mitigation measures will be determined. These will be incorporated into the OCEMP which will be produced for the NWL and will incorporate measures such as best practicable means (BPM) to reduce noise and vibration levels during construction works.

OPERATION

3.3.2. As adverse operational road traffic noise impacts are likely at some receptors close to the NWL, mitigation measures have been considered as follows:

3.3.3. The NWL has been designed to avoid passing close to noise sensitive receptors where practicable. Where possible the road will be partially screened from nearby receptors by the topography of the surrounding landscape. Along the NWL route there will be some raised earth bunds (earthworks) to integrate the road into the landscape and to provide some screening from road traffic noise.

3.3.4. A low noise road surface will be installed along the length of the NWL.

3.3.5. The current proposals for the River Wensum viaduct include a multi-purpose environmental barrier on the outer edges which may provide noise mitigation from road traffic using the viaduct. Additional noise modelling work will be undertaken at the ES stage to understand the potential noise benefits from the barrier, which will be considered alongside other environmental factors.

[4] Design Manual for Roads and Bridges LA 111 Noise and Vibration, Revision 2, May 2020

4 CULTURAL HERITAGE

4.1.1. Cultural Heritage (also referred to as 'the historic environment') comprises above ground and buried heritage assets including the setting of sensitive (designated) heritage assets, along with archaeological remains and paleoenvironmental (An environment of a past geological age) deposits.

4.2 BASELINE

BUILT HERITAGE

4.2.1. There are no statutory or locally designated heritage assets within the NWL Boundary.

4.2.2. For the purposes of the assessment of the setting (how the local landscape/views effect the experience of the asset), a study area of 1km around the NWL Boundary has been used based on DMRB LA106 guidance and professional judgement. Reference was made to assets beyond the study area where such assets are particularly significant or contribute to current understanding of the historic environment.

4.2.3. Above ground heritage assets whose setting may be affected by the proposals comprise:

- Barn 50m north west of Low Farmhouse (listed Grade II);
- The Lodge (listed Grade II.;
- Church of St Margaret (listed Grade II*);
- Water cistern at south east corner of St Margaret's Churchyard (listed Grade II);
- Garden Walls to west of Morton Hall (listed Grade II);
- Morton Hall (listed Grade II);
- Garden Walls including Owl House at Home Farm, Morton Hall Estate (listed Grade II);
- Church of All Saints including boundary wall to churchyard (listed Grade I);
- Weston Longville War Memorial (listed Grade II);
- Former Spread Eagle Public House (listed Grade II);
- Green Farmhouse (listed Grade II);
- Church of St Peter (listed Grade I);
- Stables and Coach House to Honingham Hall (listed Grade II);
- Berry Hall (listed Grade II);
- Icehouse (listed Grade II);
- 39, 40 and 41 The Street (listed Grade II); and
- Honingham and East Tuddenham War Memorial (listed Grade II).

4.2.4. For undesignated buried heritage assets, a study area of 500m from the NWL Boundary (based on DMRB LA106 guidance and professional judgement) was applied to determine the nature, extent, preservation and significance of any known or possible buried heritage assets present within or in proximity to the NWL Site Boundary.

ARCHAEOLOGY

4.2.5. The NWL does not pass through any known areas of historic settlement. Norfolk Historic Environment Record (HER) data shows several non-designated heritage assets which would potentially be impacted by the construction of the NWL. These comprise:

- Several areas of cropmarks of ditches and field boundaries, either undated or of medieval to post-medieval date;
- Areas of cropmarks of possible enclosures of Iron Age to Roman date;
- Findspots of prehistoric flint flakes, Roman and post-medieval finds;
- A World War Two accommodation and training site at Morton Hall;
- Attlebridge World War Two Airfield; and
- Honingham Park, an 18th century landscape park.

4.2.6. The northern part of the NWL is located on the Wensum floodplain and a tributary of the Tud, Foxburrow Stream, runs through the central part of the NWL. There is potential for the river alluvial sediment in these areas to contain paleoenvironmental remains.

4.2.7. There have been eleven archaeological investigations undertaken by other schemes that were either carried out within or partially within the NWL Boundary. Records from these investigations will inform the ES.

4.2.8. A geophysical survey of the NWL route has identified probable and possible archaeological activity, including possible enclosures with internal features, which are suggestive of settlement activity.

4.2.9. Trial trenching investigation is ongoing and is being undertaken to inform decision making. Trial trenching is a method of archaeological evaluation used to estimate the archaeological potential of a site. Trenches are located at intervals across a site leaving the rest untouched.

4.3 POTENTIAL IMPACTS

4.3.1. Potential impacts are outlined below and an assessment of effects will be undertaken and reported in the ES.

BUILT HERITAGE

4.3.2. The NWL would introduce a new road impacting the setting of other built heritage assets in the study area. This would affect how several built heritage assets are currently experienced and visual and noise impacts from traffic are also possible. The lighting required to the A47 junction would be noticeable outside daylight hours but this is not likely to significantly impact any assets within the study area.

4.3.3. The Grade II listed Barn 50m NW of Low Farm House is located 5m to the east of the NWL Site boundary. The NWL would introduce a new road into the asset's immediate and wider setting, impacting on its isolated position and surrounding rural agricultural landscape.

4.3.4. The NWL would potentially impact on the setting of the following designated heritage assets:

- Barn 50m north west of Low Farm House (listed Grade II);
- The Lodge (listed Grade II);
- Church of St Margaret (listed Grade II*);

- Garden Walls to west of Morton Hall (listed Grade II);
- Morton Hall (listed Grade II);
- Garden Walls including Owl House at Home Farm, Morton Hall Estate (listed Grade II);
- Church of All Saints including boundary wall to churchyard (listed Grade I);
- Church of St Peter (listed Grade I); and
- Stables and Coach House to Honingham Hall (listed Grade II).

ARCHAEOLOGY

4.3.5. Removal of soil across the NWL may severely disturb any archaeological remains within the footprint.

4.3.6. Construction works requiring excavations are likely to remove any archaeological remains within the excavation footprint. Excavations would be required for foundations on the road carriageway, the viaduct piers, foundations of road bridges, proposed attenuation ponds, drainage system, and service trenches.

4.4 POTENTIAL MITIGATION MEASURES AND ENHANCEMENT OPPORTUNITIES

BUILT HERITAGE

4.4.1. Appropriate screening as part of the NWL landscape design along the verges will consider built heritage assets to maximise mitigation of the visual impacts from the NWL as far as practicable, whilst respecting the characteristics of the current rural agricultural landscape. This will be considered and reported in the ES.

ARCHAEOLOGY

4.4.2. Further archaeological evaluation is required. The first stage of the evaluation, the geophysical survey, has been carried out. Currently an archaeological trial trench evaluation is in progress.

4.4.3. The results of the evaluation will allow appropriate mitigation to be determined following the submission of the report. Mitigation normally comprises preservation by record: advancing understanding of asset significance through targeted archaeological excavation in advance of development. This might be combined with a watching brief during ground works for remains of lesser significance. In the unlikely event that nationally important remains are present, preservation in situ may be required.

5 LANDSCAPE AND VISUAL EFFECTS

5.1 BASELINE

LANDSCAPE

5.1.1. For the purposes of the assessment a 2km study area is used in accordance with best practice guidance, namely GLVIA3[5].

LANDSCAPE DESIGNATIONS

5.1.2. There are no Areas of Outstanding Natural Beauty (AONB) or National Parks within the 2km study area. There are also no registered Historic Parks and Gardens, or Country Parks located within 2km of the NWL. The NWL does run through Honingham Park, which is a non-designated heritage asset.

PUBLIC RIGHTS OF WAY

5.1.3. The enjoyment of Public rights of way (PRoW) may be impacted as a result of changes to views.

5.1.4. There are no National Trails or Sustrans Cycle Routes in close proximity to the NWL. 'Sustrans: Fakenham to Harwich' route runs 1.5km north of the NWL and Marriott's Way runs from Aylsham to Norwich north-east of the NWL. There are a number of PRoW in close proximity to the NWL area including:

- Attlebridge FP4;
- Attlebridge FP5;
- Ringland FP1;
- Ringland FP2;
- Ringland FP3;
- Ringland FP4;
- Ringland FP7;
- Weston Longville FP9; and
- Honingham RB1.

5.2 POTENTIAL IMPACTS

5.2.1. The assessment of potential impacts of the NWL on landscape considers the effects of change and development on landscape. Visual amenity assessment is concerned with the views of those who may be affected by the NWL.

CONSTRUCTION

5.2.2. Construction of the NWL is expected to potentially affect landscape character and visual amenity in the following ways:

- Effects on the topography of the NWL Boundary;
- Effects on the cover of trees and hedgerows within the NWL Boundary;

[5] Landscape Institute and Institute of Environmental Management & Assessment, Guidelines for Landscape and Visual Impact Assessment, 3rd Edition, Routledge [paragraph 5.2]

- Effects on local landscape of the site and within 2km of the NWL Boundary;
- Effects on views from heritage features;
- Effects on the views available; and
- Visual intrusion of construction activities.

OPERATION

5.2.3. During operation the NWL, is expected to potentially affect landscape character and visual amenity as follows:

- Change of views where there is currently an absence of an existing road;
- Changes in perception of a currently rural, dark and tranquil setting;
- Increased visibility of new structures;
- The presence of a viaduct structure, modifying river valley perception;
- Alteration of existing landform (cuttings and embankments);
- Loss of established field pattern;
- Effects on views from heritage features; and
- Effects on views available to residents, users of highways and PRoW users.

5.2.4. Artificial lighting during operation is provided at the junction to the National Highways A47 Scheme and will be experienced in the context of existing lighting but is not expected to significantly affect landscape character and visual amenity.

5.3 POTENTIAL MITIGATION MEASURES AND ENHANCEMENT OPPORTUNITIES

CONSTRUCTION

5.3.1. Potential construction mitigation measures with the intention to avoid or reduce the potential for significant effects include:

- Temporary construction lighting will be minimised in extent and use as far as practicable and positioned to minimise light spillage to adjacent areas;
- Construction working area to be contained and constrained to minimise land take and vegetation loss; and
- Reinstatement of surrounding field boundaries and field margins.

OPERATION

5.3.2. A landscape design has been developed to avoid, reduce, and mitigate potential impacts of the NWL while integrating it into the surrounding landscape context. This includes the design of the NWL verge planting to provide screening of the road and integrate the road into the landscape

5.3.3. Other potential design measures with the intention to avoid or reduce the potential for significant effects include:

- A scheme responsive to the local context;
- A landscape design that integrates the project into the local area and aligns with ecological mitigation;
- Avoiding loss of existing vegetation where possible;
- Varied embankments to integrate the NWL into the landscape and inclusion of planted screening bunds where appropriate;
- Selective placement of scrub and woodland and hedgerow planting to screen local views;
- Inclusion of planting diversity;
- Landscaping located on the proposed green bridges; and
- Improving connectivity of existing woodlands, including habitat connectivity.

6 BIODIVERSITY

6.1 BASELINE

6.1.1. A suite of surveys have been undertaken to establish the baseline environment and this data will be used as part of the baseline for the ES. The data will also be used to underpin reporting to inform a Habitats Regulations Assessment (HRA) in accordance with the Conservation of Habitat and Species Regulations 2017 (as amended) to assess the effects of the NWL on Internationally Designated Sites.

DESIGNATED SITES

Internationally Designated Sites

6.1.2. A desk study using Natural England's Multi Agency Geographical Information for the Countryside (MAGIC)[6] identified the following internationally designated sites within 10km of the NWL (increased to 30km where designated for bats). Internationally Designated Sites are shown in **Appendix A - Figure 4.**

Table 6-1 – Internationally Designated Sites

Site and Designation	Approximate Distance and Direction from the NWL Boundary
River Wensum SAC[7]	Within the NWL Boundary
Norfolk Valley Fens SAC[8]	6.3km south-west
Paston Great Barn SAC[9]	26km north-east

Nationally Designated Sites

6.1.3. A desk study, using the online resource MAGIC[10], identified the following nationally designated sites within 5km of the NWL. Nationally Designated Sites are shown in **Appendix A - Figure 3**.

6 MAGIC (2002). Multi-agency Geographic Information for the Countryside.
7 JNCC. River Wensum. Designated Special Area of Conservation (SAC). https://sac.jncc.gov.uk/site/UK0012647
8 JNCC (n.d.). Norfolk Valley Fens. Designated Special Area of Conservation (SAC). Available online at: https://sac.jncc.gov.uk/site/UK0012892 [Last accessed 23/07/2021].
9 JNCC(n.d.) Paston Great Barn. Designated Special Area of Conservation (SAC). Available online at: http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?eucode=UK0030235 [Last accessed 23/07/2021].
10 MAGIC (2002). Multi-agency Geographic Information for the Countryside.

Table 6-2 – Nationally Designated Sites within 5km of the NWL

Site and Designation	Approximate Distance and Direction from the NWL
River Wensum SSSI[11]	Within the NWL Boundary
Swannington Upgate Common SSSI[12]	2.2km north
Alderford Common SSSI[13]	2.3km north-west
Hockering Wood SSSI[14]	2.4km west
Whitwell Common SSSI[15]	4.9km north-west

6.1.4. NCC is aware that Natural England (NE) are considering including an area south of the A1067 including part of the proposed route for the NWL on a shortlist for potential Site of Special Scientific Interest (SSSI) consideration due to the Barbastelle bat habitat it contains. A decision whether to shortlist by NE may be made in July 2022. Including this area on the shortlist is not a commitment by NE to designate a SSSI, only to investigate the site further. This further investigation could take many months if not years to complete. Until that is completed, the decision maker will continue to need to determine the extent to which impacts to bats will be a material consideration and the weight that needs to be applied to that consideration in light of Natural England's process taking place.

Local Non-Statutory Designated Sites

6.1.5. A desk study identified the following local non-statutory designated sites within 2km of the NWL. Local Non-Statutory Designated Sites are shown in **Appendix A – Figure 3**.

Table 6-3 – Local Non-Statutory Designated Sites within 2km of the NWL

Site and Designation	Approximate Distance and Direction from the NWL Boundary
River Wensum Pastures, Ringland Estates County Wildlife Sites (CWS) (Ref: 2303)	Within the NWL Boundary
Broom & Spring Hills CWS (Ref: 1341)	Within the NWL Boundary
Wensum Pastures at Morton Hall CWS (Ref: 2070)	Within the NWL Boundary
Land adjoining Foxburrow Plantation CWS (Ref: 2116)	Within the NWL Boundary
Fakenham Road, Roadside Nature Reserve (RNR) (Ref: 2116)	Within the NWL Boundary
Primrose Grove CWS (Ref: 2305)	Within the NWL Boundary

[11] Natural England (1993). River Wensum. Site of Special Scientific Interest (SSSI). Available online at: https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1006328.pdf [Last accessed 23/07/2021].
[12] Natural England (1985). Swannington Upgate Common. Site of Special Scientific Interest (SSSI). Available online at: https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1000149.pdf [Last accessed 23/07/2021].
[13] Natural England (1986). Alderford Common. Site of Special Scientific Interest (SSSI). Available online at: https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1000483.pdf [Last accessed 23/07/2021].
[14] Natural England (1984). Hockering Wood. Site of Special Scientific Interest (SSSI). Available online at: https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1002623.pdf [Last accessed 23/07/2021].
[15] Natural England (1985). Whitwell Common. Site of Special Scientific Interest (SSSI). Available online at: https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1002058.pdf [Last accessed 23/07/2021].

Site and Designation	Approximate Distance and Direction from the NWL Boundary
Gravelpit Plantation and Church Hill CWS (Ref: 2304)	Adjacent to the NWL Boundary
Old Covert, Wood Lane CWS (Ref 2109)	10m west
Mouse Wood CWS (Ref: 2050)	15m west
Attlebridge Hills CWS (Ref: 1343)	20m north
Triumph & Foxburrow Plantations CWS (Ref:1344)	400m north
Walsingham Plantation CWS (Ref: 1351)	510m east
Hall Hills/Ringland Covert CWS (Ref: 2105)	570m east
Church Hill Common CWS (Ref: 1340)	630m east
Fen West of East Tuddenham CWS (Ref: 660)	660m south
Fen Plantation CWS (Ref: 2117)	670m south
River Tud at Easton and Honingham CWS (Ref: 250)	675m south-east
Park Grove CWS (Ref: 2033)	730m west
Dryhill Plantation CWS (Ref: 2113)	900m east
Church Meadow, Alder Carr, Three Corner Thicket and Nursery Plantation CWS (Ref: 2296)	960m south-east
Jennis' Wood CWS (Ref: 2113)	1.1km east
Marriott's Way CWS (Ref: 2176)	1.2km north
Ave's Gap CWS (Ref:2306)	1.3km east
Lake adjacent to Concrete Plant CWS (Ref: 1346)	1.6km north-west
Bush Meadow Plantation CWS (Ref: 1347)	1.7km north-west
Weston Meadow CWS (Ref: 1345)	1.7km west
Lenwade Pits (East) CWS (Ref: 1349)	1.8km north-west
Ringland Pits CWS (Ref: 1339)	2km east

HABITAT

Ancient Woodland

6.1.6. Two parcels of ancient woodland, as listed on the national Ancient Woodland Inventory, are present within 200m of the NWL Boundary. These are shown in **Appendix A – Figure 3**:

- Primrose Grove abuts the NWL Boundary (though is approximately 15m south of the nearest edge of the NWL route); and
- Mouse Wood is located approximately 10m to the west of the NWL Boundary, separated by Wood Lane (B1535) which provides an access route to the NWL Boundary.

6.1.7. The results of the woodland survey undertaken for the NWL are described in the section detailing National Vegetation Classification (NVC).

Habitats of Principal Importance (HPI)

6.1.8. The desk study identified the following HPI within 200m of the NWL Boundary:

- Rivers;
- Ponds;
- Floodplain Grazing Marsh[16];
- Deciduous Woodland (officially Lowland Mixed Deciduous Woodland)[17]; and
- Lowland Fens[18].

6.1.9. Phase 1 Habitat and National Vegetation Classification (NVC) surveys have been completed to provide baseline habitat data and to consider the types and distribution of habitats.

6.1.10. Survey work has identified the following HPI in addition to those identified in the desk study:

- Lowland meadow;
- Purple Moor Grass and rush pasture;
- Hedgerows; and
- Wet Woodland.

Important Hedgerow Survey

6.1.11. A hedgerow survey was undertaken in 2020. The survey identified a total of 25 hedgerows within or partially within the NWL Boundary. All of the hedgerows, aside from one, were concluded to qualify as HPI under the Natural Environment and Rural Communities Act (NERC) 2006.

6.1.12. A total of eight hedgerows qualified as Important (as defined under the Hedgerow Regulation 1997), however none of the hedgerows were found to contain ancient or veteran features (hedgerow locations are shown in Appendix A – Figure 5: Ecological Constraints, Habitats and Protected Species.

River Habitat Survey

6.1.13. A River Habitat Survey (RHS) was completed in Summer 2020 along a 500m stretch of the River Wensum between TG 14037 15422 and TG 13725 15669 which encompassed the NWL Boundary. Given a refinement to the alignment this survey is subject to an updated River Condition Assessment survey in 2022 to survey the new crossing point of the River Wensum by the NWL. The results outlined in this section will be updated accordingly once the survey is completed. The survey data will inform the ES and reporting to inform HRA. The data will also be used to inform the Water

[16] UK Biodiversity Action Plan Priority Habitat Descriptions: Coastal and Floodplain Grazing Marsh. Available online at: http://data.jncc.gov.uk/data/82b0af67-d19a-4a89-b987-9dba73be1272/UKBAP-BAPHabitats-07-CoastFloodGrazingMarsh.pdf. [Last accessed 23/07/2021].

[17] UK Biodiversity Action Plan Priority Habitat Descriptions: Lowland Mixed Deciduous Woodland. Available online at: http://data.jncc.gov.uk/data/2829ce47-1ca5-41e7-bc1a-871c1cc0b3ae/UKBAP-BAPHabitats-30-Lo CIEEM (2017) Guidelines for Preliminary Ecological Appraisal, 2nd edition. Chartered Institute of Ecology and Environmental Management, Winchester. wlandMixedDecWood.pdf. [Last accessed 23/07/2021].

[18] UK Biodiversity Action Plan Priority Habitat Descriptions: Lowland Fens. Available online at: http://data.jncc.gov.uk/data/6fe22f18-fff7-4974-b333-03b0ad819b88/UKBAP-BAPHabitats-27-LowlandFens.pdf [Last accessed 23/07/2021].

Framework Directive (WFD), which aims to prevent deterioration of the water environment and improve water quality through appropriate management.

6.1.14. The 2020 survey determines a Habitat Modification Score (HMS) as an indication of artificial modification to the river channel. An HMS of 380 for the River Wensum places the site into the 'obviously modified' category.

6.1.15. The 2020 survey determines a Habitat Quality Assessment (HQA) as a broad indication of overall habitat diversity provided by natural features in the river corridor. The HQA class for the River Wensum was calculated as 3, describing the habitat quality as 'Fair'.

6.1.16. The 2020 survey on the River Wensum categorised the flow type predominantly as smooth with areas of rippling. The plant community visible along the survey section included emergent broad-leaved herbs, emergent reeds/sedges/rushes/grasses/horsetails, floating-leaved (rooted), free-floating, submerged broad-leaved, submerged linear-leaved, and submerged fine-leaved and filamentous algae.

6.1.17. An RHS was also undertaken in Summer 2021 on Foxburrow Stream, a tributary of the River Tud, which flows west to east in the southern aspect of the NWL. The Foxburrow Stream flows through rough pasture and shows evidence of realignment, bank reprofiling and livestock poaching. The river corridor was densely vegetated with tall herbs on both banks and some scattered trees shading the channel. The wetted channel was narrow and uniform in flow type, habitat features and substrate. At the time of the survey, the Foxburrow Stream had a low flow and shallow average water depth of 10cm. In general, the Foxburrow Stream contained a modest diversity of aquatic plant species.

FLORA (PLANTS)

Protected/Notable Flora

Phase 1 Habitat Survey

6.1.18. A Phase 1 Habitat Survey covering the NWL Boundary was completed in 2020 to record dominant plant species and classify habitats according to their vegetation type.

6.1.19. The survey recorded a range of habitats within the NWL Boundary, including the River Wensum and Wensum floodplain with its associated floodplain grazing marsh, streams and ditches. Moving south from the floodplain, the NWL Boundary incorporates sections of a series of woodlands which have been referred to collectively as the 'northern woodlands', relating to their northerly position within the NWL Boundary. Continuing south, the NWL Boundary becomes predominantly an intensive arable landscape occasionally intersected by hedgerows, with a segment of an unnamed woodland also included to the south of Ringland Lane. As the NWL progresses in a southerly direction, The Broadway woodland is reached with Foxburrow Plantation woodland following this, which is bordered to the south by Foxburrow Stream and associated wet grassland area. Intensive arable land, compartmented by hedgerows, forms the remaining area of the NWL Boundary to its southern end.

6.1.20. An updated survey via UK Habitat Classification will be undertaken in 2022. This will inform Biodiversity Net Gain calculations for the Scheme.

Macrophyte Survey

6.1.21. Macrophytes are aquatic plants growing in or near water. A macrophyte survey was conducted along a 100m stretch of the River Wensum and two of the adjoining floodplain ditches in 2020. A total of 19 macrophyte species were recorded.

6.1.22. European bur-reed *Sparganium emersum* was the most dominant species, accounting for 30% of macrophyte cover, closely followed by clasping-leaf pondweed *Potamogeton perfoliatus*, which accounted for 25% of cover. Reed sweet grass *Glyceria maxima*, fennel pondweed *Potamogeton pectinatus,* and greater water moss *Fontinalis antipyretica* were also observed.

6.1.23. Stream water-crowfoot *Ranunculus penicillatus*, a species characteristic of the River Wensum SAC, was the only species of water-crowfoot sampled.

6.1.24. Furthermore, four species associated with *Ranunculus spp*. in 'watercourses of plain to montane levels' were sampled; watercress *Rorippa nasturtium-aquaticum*, water forget-me-not *Myosotis scorpioides*, blunt-fruited water starwort *Callitriche obtusangula,* and common water starwort *Callitriche stagnalis*.

6.1.25. A macrophyte survey was also undertaken in Summer 2021 on Foxburrow Stream.

6.1.26. An updated macrophyte survey of the River Wensum and Foxburrow stream will be completed in 2022. The results of the surveys will be used to inform the ES.

FAUNA (ANIMALS)

6.1.27. Surveys have been undertaken for a wide range of fauna to determine which species are found in and around the proposed route of the NWL. The survey areas for each species/species group have been designed in accordance with the relevant survey guidelines and agreed in consultation with Natural England. An overview of the surveys undertaken for each species/species group is provided below, with detailed baseline survey reports available online[19].

6.1.28. **Appendix A – Figure 5** shows the survey findings of habitats and protected species.

White-clawed Crayfish Survey

6.1.29. A white-clawed crayfish survey was undertaken within the River Wensum in 2020, covering a 200m section of the river, 100m either side of the viaduct crossing point according to the previous alignment.

6.1.30. No white-clawed crayfish were recorded; however, the survey identified the presence of the non-native signal crayfish *Pacifastacus leniusculus* within the surveyed stretch of the River Wensum. These results are considered to appropriately apply to the current alignment.

Fish Survey

6.1.31. An electric fishing survey (using an electric current to stun but not harm the fish within a watercourse to allow survey) was undertaken in 2020 to complete the baseline.

[19] WSP on behalf of NCC (2020, 2021). Norwich Western Link Road, Ecology Survey Reports – 2019-2021. Available: https://www.norfolk.gov.uk/roads-and-transport/major-projects-and-improvement-plans/norwich/norwich-western-link/timeline

6.1.32. The survey was conducted over a 225m stretch of the River Wensum, as well as a 65m stretch of adjoining floodplain ditch. A survey was also conducted over a 90m stretch of Foxburrow Stream.

6.1.33. The surveys were undertaken with reference to Environment Agency guidance and British standards. Fish welfare was strictly maintained and monitored during the survey, and fish were captured and returned with no lasting ill-effects on health.

River Wensum

6.1.34. A total of six fish species were caught during the electric fishing survey on the River Wensum. The species captured included dace *Leuciscus leuciscus*, pike *Esox lucius*, chub *Squalius cephalus*, roach *Rutilus rutilus*, gudgeon *Gobio gobio*, and minnow *Phoxinus phoxinus*. No species of conservation importance were caught.

Ditch Network

6.1.35. A total of three species of fish were caught during the qualitative (presence/absence) survey of the ditch network, including brook/river lamprey *Lampetra sp.* (which are species of conservation importance), minnow, and three-spined stickleback *Gasterosteus* aculeatus.

Foxburrow Stream

6.1.36. No fish were caught during the quantitative electric fishing survey of Foxburrow Stream.

Amphibians

Great Crested Newt Survey

6.1.37. Great crested newt (GCN) surveys, comprising Habitat Suitability Index (HSI) and Environmental DNA (eDNA) presence/likely absence surveys, were undertaken on ponds within and up to 500m from the NWL Boundary. Ponds which returned a positive result for GCN eDNA were then subject to further population size class assessment surveys in 2021.

6.1.38. The results of the eDNA surveys indicated the presence of GCN in two waterbodies (15 and 16) situated approximately 280m and 272m from the NWL Boundary. Further surveys were therefore undertaken at these water bodies in 2021 to establish population size class. This recorded a peak count of one adult GCN in Water Body 15, indicating the presence of a 'small' population in accordance with standard guidelines[20]. However, no GCN were recorded in Water Body 16 during any of the six survey visits, indicating that the positive eDNA result returned in 2020 was likely to be a false positive. GCN were therefore considered to be likely absent from this water body following the population size class assessment surveys.

Common Toad Survey

6.1.39. The impact assessment for common toad will be informed by a desk-based habitat level assessment which will also feed into the Biodiversity Net Gain (BNG) assessment.

6.1.40. This assessment will use existing habitat data obtained from the Phase 1 Habitat Survey, as well as additional online Geographic Information System (GIS) databases and incidental and local records to determine the likely presence/absence of common toad in the NWL Boundary. This approach has been agreed with Natural England following consultation.

[20] English Nature. (2001). Great Crested Newt Mitigation Guidelines. Peterborough: English Nature.

Birds

Wintering Bird Survey

6.1.41. Wintering bird surveys were undertaken in 2019/20 and 2020/21 to complete the baseline.

6.1.42. The survey area extended up to 100m from the NWL Boundary with four survey visits undertaken each year, with one visit each month (November to February inclusive).

6.1.43. Initial survey work undertaken in 2019/20 returned no observations of significant over-wintering assemblages, with the NWL predominantly supporting small numbers of farmland species.

6.1.44. The second year of survey work in 2020/21 recorded a total of 74 species on or over the Survey Area. This included 39 species which are legally protected or species of conservation concern.

Breeding Bird Survey

6.1.45. Breeding bird surveys were undertaken in 2021.

6.1.46. Breeding bird surveys were undertaken up to 100m from the NWL Boundary. A total of six surveys were undertaken across April, May, and June 2021. Species recorded included several species listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) including hobby, kingfisher, barn owl and red kite.

Barn Owl Survey

6.1.47. Barn owl surveys were completed in 2021 to complete the baseline.

6.1.48. Following consultation with Natural England and a local barn owl expert, surveys were conducted with the aim of identifying nesting sites and foraging habitat within 1km of the NWL alignment to inform mitigation for likely impacts on the barn owl breeding population in the area.

6.1.49. The nest verification surveys identified a total of three occupied breeding sites and thirteen potential nest sites within trees and buildings. No confirmed occupied breeding sites were located within the NWL Boundary, the closest being a barn owl nest box situated approximately 70m west of the NWL Boundary.

Bats

6.1.50. An extensive suite of bat surveys has been undertaken in relation to the NWL since 2019. Surveys have recorded several bat species, including the rare Annex II barbastelle bat, which is one of the key species located within the study area. All bat surveys have been undertaken with reference to good practice guidelines (including Collins 2016[21]). An overview of each of the different bat surveys undertaken is provided below.

Bat Surveys of Trees (Excluding Radio-Tracking)

6.1.51. Survey data for trees includes:

- Ground level tree assessments of all trees within the survey area (100m of the alignment and/or up to 25m from the NWL Boundary); and

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

- Aerial tree inspections of trees assessed to have high or moderate suitability to contain bat roosts or known to be used by roosting bats (undertaken during the summer and/or winter to identify different roost types).

6.1.52. Dusk emergence and dawn re-entry surveys to identify and characterise bat roosts where other survey types were not suitable (for example when aerial inspections could not be completed safely).

6.1.53. Surveys between 2019 and 2021 inclusive have identified a total of 36 trees supporting bat roosts within the survey area, comprising the following:

- One barbastelle summer day roost;
- Five brown long-eared bat summer day roosts, one brown long-eared bat maternity roost and one brown long-eared bat hibernation roost;
- Twelve soprano pipistrelle roosts, including summer day roosts. One tree supporting a hibernation roost for soprano pipistrelle;
- Four common pipistrelle roosts, all of which were summer day roosts;
- Three summer day roosts for natterer's bat;
- Two trees with unidentified *Myotis* sp. roosts, including a hibernation roost and a summer day roost;
- One tree supporting a hibernation roost for both an individual noctule and individual brown long-eared bat;
- One summer day roost for an unidentified Pipistrellus sp., and one hibernation roost for unidentified *Pipistrellus* sp.; and
- Three trees supporting roosts of unknown species.

Bat Surveys of Structures

6.1.54. A total of 29 structures were identified within and up to 100m from the NWL Boundary, and all of these were subject to an external survey to assess the suitability for bat roosts to be present[22]. Two of these structures were subject to internal surveys where the building was vacated and was deemed safe to enter. It was not possible to enter other structures due to COVID-19 restrictions. A precautionary approach to assigning roosting suitability was taken where internal inspection was not possible.

6.1.55. Of the 29 structures, five were confirmed to be used by roosting bats, eight were assigned a high roosting suitability, four were considered to have moderate suitability, and a further five structures were assigned low suitability. The remaining seven structures were assessed to have negligible roosting suitability.

6.1.56. Seven structures were subject to dusk emergence and dawn re-entry surveys in 2021 to gather further data, due to proximity to the NWL and the likely severance of surrounding connecting habitat. Summer day roosts were recorded in six of the seven structures, three of which were already confirmed roosts.

[22] WSP (2022). 2021 Bat Roost Survey Report. Available: https://www.norfolk.gov.uk/roads-and-transport/major-projects-and-improvement-plans/norwich/norwich-western-link/timeline

6.1.57. Hibernation surveys of structures within and up to 500m from the NWL Boundary, with potential to contain hibernation roosts, were completed during winter 2019-20 and winter 2020-21. Five hibernation roosts were identified.

Bat Activity Surveys

Vantage Point Surveys

6.1.58. Vantage point surveys were undertaken in 2020, with further survey work conducted in 2021 to complete the baseline[23].

6.1.59. These surveys focused on linear features such as woodland edges, glades, hedgerows, and watercourses intersected by the NWL, where higher barbastelle activity was identified during survey work in 2019.

6.1.60. The surveys have identified key barbastelle and *Myotis* sp. commuting routes across the NWL Boundary.

Radio-tracking

6.1.61. Radio-tracking was initially undertaken in May 2019, with follow-up survey-work conducted in 2021 to complete the baseline.

6.1.62. Survey work in 2021 was undertaken over three sessions to capture both pre and post maternity season. The survey sessions included the trapping of bats at pre-determined locations, predominantly in woodland/tree-dominated habitats adjacent to, or within the radiotracking survey area (up to 6km from the NWL). Trapping was undertaken using harp traps and mist nets, alongside acoustic lures (Sussex Autobats) to improve trapping efficiency.

6.1.63. In accordance with the conditions of a Natural England project licence, target bats were radio-tagged, with a primary species of interest barbastelle and secondary priority species including bats from the genera *Myotis*. Tagged bats were simultaneously or subsequently followed by radio tracking teams during the survey session, to locate and identify roost sites and to examine nocturnal flying activity of the tagged bats, with a focus on collecting activity data for bats within the study area and other key areas considered potentially important to barbastelle bat population(s). Where access permitted, emergence counts of roost sites were undertaken to determine the status/function of the roost.

6.1.64. Bat trapping undertaken in May, June, and August 2021, over 11 trapping nights in eight locations, caught a total of 309 bats of seven species. A total of 27 bats were radio-tagged including four species; barbastelle, Natterer's bat, Daubenton's bat, and brown long-eared bat, of which 22 were barbastelles.

6.1.65. A total of 38 bat roosts were located, of which 26 were verified through emergence surveys. Most roosts were recorded in trees however, one roost, a brown long-eared bat roost, was in a residential bungalow.

6.1.66. The highest roost count was a Daubenton's bat roost with a count of 50 bats located in Royal Norwich Golf Course on 18 May 2021. The highest recorded roost count of 21 barbastelles was recorded in Primrose Grove on 12 June 2021 and three tagged bats 5, 6 & 7 were all recorded

[23] WSP (2022). 2021 Bat Activity Report. Available: https://www.norfolk.gov.uk/roads-and-transport/major-projects-and-improvement-plans/norwich/norwich-western-link/timeline

roosting together in this location. An additional maternity roost was identified within Rose Carr. With a refinement to the alignment this roost is now not within the Site Boundary. The highest roost count of Natterer's bat was 10 bats in Morton Plantation on 18 and 20 May respectively[24]. The highest roost count for brown long-eared bat was in a bungalow off Broadway on 10 June 2021, when 20 bats were recorded emerging.

Back Tracking Surveys

6.1.67. In addition to the above survey types, back-tracking surveys were completed in 2020. The surveys recorded barbastelle commuting and foraging activity across the NWL Boundary, as well as behaviour consistent with the suspected presence of a barbastelle roost in proximity to the Broadway.

6.1.68. The surveys included dusk and dawn back tracking surveys, completed by mobile survey teams (up to ten surveyors), with an aim to identify movement of bats (with a particular focus on barbastelle) through woodlands and across larger areas through detection within different 'surveyor compartments'. The survey method also identified tree roosts within surveyor compartments.

Automated Detector Surveys

6.1.69. Automated static bat detectors (a device that records bat calls) have been deployed in multiple locations along the NWL and in adjacent habitat to monitor bat activity between 2019 and 2021 inclusive. Deployment locations have been selected to include habitat that will be impacted by the NWL and nearby habitat which will not be directly affected, enabling comparison between locations and habitat types. The data analysis for 2021 is ongoing and will be reported in full to support the ES baseline.

6.1.70. At least eight bat species were recorded, using habitats within proximity of the NWL, during the automated bat detector surveys in 2020. The confirmed species or species groups include:

- *Myotis sp*;
- Noctule;
- Nyctalus sp. (this encompasses both noctule and Leisler's);
- serotine bat *Eptesicus serotinus*;
- barbastelle;
- brown long-eared bat;
- common pipistrelle
- soprano pipistrelle; and
- Nathusius' pipistrelle.

6.1.71. The areas with, cumulatively, the highest number of bat passes per night in 2020 were The River Wensum, Rose Carr and The Nursery, Long Plantation, the woodland south of Ringland Lane, The Broadway, and Foxburrow Plantation. All locations recorded calls of at least six species in addition to common and soprano pipistrelle, including barbastelle, Myotis sp. (this could represent multiple

[24] WSP (2022). 2021 Bat Radio Tracking Survey Report. Available: https://www.norfolk.gov.uk/roads-and-transport/major-projects-and-improvement-plans/norwich/norwich-western-link/timeline

species), noctule, Nyctalus sp. (this could represent noctule or Leisler's bat), brown long-eared bat, serotine, and Nathusius' pipistrelle.

2022 Surveys

6.1.72. A limited amount of bat surveys will be undertaken in 2022. These will focus on final gap filling surveys via crossing points and vantage points in order to supplement the comprehensive surveys data collected to date.

Badgers

Badger Survey

6.1.73. Badger surveys covering up to 50m from the NWL Boundary were undertaken in 2020.

6.1.74. The surveys identified the presence of badgers across the NWL Boundary, including evidence of setts, commuting, and foraging activity.

6.1.75. Badger activity was recorded at several locations within the NWL Boundary, with setts present in woodlands in the north and south. In the south, a single sett with a single partially used entrance hole was recorded. Additional signs of badgers recorded during the survey included the presence of latrines, badger hair, and snuffle holes. In the north, the field survey identified one active main sett and one potential main sett, along with four annexes, five subsidiary, and 16 outlier setts within these woodlands. Additional signs of badger recorded during the survey included latrines, badger hair, snuffle holes, and bedding. A number of prominent mammal runs were also present.

6.1.76. Badger surveys will be updated in 2022.

Badger Bait Marking Survey

6.1.77. Following on from the initial badger survey work, further badger bait marking surveys were undertaken in 2021 to establish the territory sizes of badger clans that may be impacted by the NWL to the complete the baseline.

6.1.78. The surveys involved the provision of badger bait (in this instance peanuts and oats mixed with syrup and molasses mixed with harmless indigestible plastic-coloured markers) outside entrances of selected setts within the survey area (within at least a 500m buffer of each main or suspected main sett).

6.1.79. Camera traps were also deployed at the same time as the bait marking survey in order to increase confidence in the results by providing video evidence of specific sett badger activity.

6.1.80. The surveys identified mixing between four setts, as well as distinct territorial boundaries between two others. The deployed camera traps used to supplement the bait marking survey effort recorded badgers at three of the four locations at which they were deployed.

Otter Survey

6.1.81. Otter surveys were initially undertaken in 2020, with follow-up surveys carried out in 2021 to complete the baseline.

6.1.82. Surveys in 2020 covered all suitable watercourses and associated wetland habitat within and extended up to 300m beyond the NWL alignment (up and down stream), including the River Wensum and adjoining floodplain ditches, as well as Foxburrow Stream to the south.

6.1.83. Although no specific otter surveys were undertaken in 2019, an otter was observed within the River Wensum during the 2019 white-clawed crayfish survey. Follow-up surveys in 2020 identified a potential holt beneath tree roots on the northern bank of the River Wensum, with shell remains and several otter droppings (spraints) also present. However, further intensive investigation in 2021 found that the feature did not relate to otter, given that it did not provide sufficient shelter. Otters were also not recorded on a trail camera which focussed on the feature for a total of 68 days. Consequently, whilst otter do utilise habitats within the area surveyed, no holts were considered to be present at the time of the surveys.

6.1.84. Additionally, no evidence of otters was recorded in Foxburrow Stream in the southern aspect of the NWL and, therefore, this water course was considered unlikely to form a significant part of otter territory.

Water Vole Survey

6.1.85. Water vole surveys were initially undertaken in 2019, with follow-up surveys undertaken in 2020 to complete the baseline. Further surveys, covering a wider area of the River Wensum and associated floodplain ditches, were also completed in 2021 to inform mitigation and areas for compensation/enhancement.

6.1.86. Surveys in 2020 covered all suitable watercourses and associated riparian habitat within and extended up to 300m beyond the NWL alignment (up and down stream), including the River Wensum and adjoining floodplain ditches, as well as Foxburrow Stream to the south.

6.1.87. Surveys in 2020 confirmed the presence of water voles in the River Wensum, as well as a single adjoining floodplain ditch. Latrine counts from the surveys indicate the presence of a medium population in the River Wensum, with a low population in the adjoining ditch.

6.1.88. No evidence of water voles was recorded in Foxburrow Stream and therefore water voles have been considered likely absent from this watercourse.

Additional Species of Principal Importance (SPI) – Mammals

6.1.89. The impact assessment for additional SPI mammals will be informed by a desk-based habitat level assessment which will also feed into the BNG assessment.

6.1.90. This assessment will use existing habitat data obtained from the Phase 1 Habitat Survey, as well as additional online GIS databases and incidental and local records, to determine the likely presence/absence of additional SPI such as brown hare, harvest mouse, hedgehog, and polecat in relation to the NWL. The above approach has been agreed with Natural England following consultation.

Reptile Survey

6.1.91. Reptile surveys, which extended up to a 50m buffer from the NWL Boundary, were initially undertaken in 2019, with follow up surveys undertaken in 2020 to complete the baseline.

6.1.92. The survey work identified three common reptile species (common lizard *Zootoca vivipara*, grass snake *Natrix helvetica,* and slow-worm *Anguis fragilis*) within the survey area.

Desmoulin's Whorl Snail Survey

6.1.93. Desmoulin's whorl snail surveys were initially undertaken in 2019, with follow-up surveys undertaken in 2020 to complete the baseline. Further surveys were also undertaken in 2021 to inform areas for compensation/enhancement.

6.1.94. Surveys in 2020 covered an extensive area of the Wensum floodplain between St Margaret's Church track off the Fakenham Road to the northwest to Ringland Road to the southeast, as well as a section of Foxburrow Stream to the south.

6.1.95. This survey work indicated the presence of a scattered population of Desmoulin's whorl snail in two floodplain ditches within the NWL Boundary, as well as a large, scattered population within the Wensum floodplain to the south east close to Ringland village.

6.1.96. Desmoulin's whorl snail were not recorded during sampling along the section of Foxburrow Stream in 2020, indicating their likely absence from this area.

Terrestrial Invertebrate Survey

6.1.97. Terrestrial invertebrate surveys covering the NWL Boundary were undertaken in 2021 to complete the baseline. The survey recorded a diverse range of invertebrate fauna, which included 43 species currently regarded as Nationally Rare, Scarce, Data Deficient, or Section 41 Species of Principal Importance.

Aquatic Macroinvertebrate Survey

6.1.98. Aquatic macroinvertebrates are organisms that have no internal skeletal system, spend at least part of their life cycle in the aquatic environment, and are large enough to be observed by the naked eye. Aquatic macroinvertebrate surveys were undertaken in 2020 to complete the baseline. The survey area incorporated the location of the viaduct where it crosses the River Wensum and the culvert crossing point of Foxburrow Stream to the south.

6.1.99. The macroinvertebrate communities identified in the samples classified most of the sampling sites as moderate to fairly high conservation value, with the exception of Hall Ditch (within the Wensum floodplain) which achieved fairly high conservation value in the spring and high conservation value in the autumn survey.

6.1.100. One species of note, the grannon caddisfly *Brachycentrus subnubilus,* was identified in the samples. A total of 560 individuals of the species were recorded in the River Wensum upstream sample in spring, compared with 28 in autumn, and a single individual was found in the Foxburrow Stream autumn sample.

6.1.101. As the survey of the River Wensum was undertaken in 2020, due to the sensitivity of the SAC it is considered an updated survey will be undertaken in 2022.

6.2 POTENTIAL EFFECTS

6.2.1. **Table 6-4** provides a description of the potential likely significant effects on biodiversity features during the construction and operational phases of the NWL. It is important to note that this section has been written in line with the Chartered Institute of Ecology and Environmental Management (CIEEM) Ecological Impact Assessment (EcIA) guidelines. The potential impacts presented do not account for mitigation measures which, once implemented, would minimise/eliminate the identified likely significant effects. The potential and proposed mitigation measures are outlined in **Section 6.3** and assessment of the impacts with mitigation taken into account will be reported in the ES. The following potential likely significant effects are considered:

- Pollution;
- Disturbance;
- Habitat loss; and
- Degradation of habitat quality.

Table 6-4 – Potential Effects to be Considered in the ES

Biodiversity Feature	Phase	Likely Significant Effect (in the Absence of Mitigation)
Designated sites	Construction and Operation	The following likely significant effects are expected on designated sites as a result of the NWL. The effects will vary depending on the location and nature of the site, which will be assessed in the ES. Construction Phase Habitat loss: direct loss of habitat. Habitat degradation through pollution or reduction in air quality. Water quality reduction through sedimentation or pollution incident. Disturbance through lighting, noise, visual and vibration. Operation Phase Habitat loss: increased shading of river and floodplain once operational (viaduct). Habitat degradation through pollution or reduction in air quality. Water quality reduction through sedimentation or pollution incident. Disturbance through lighting, noise, visual (Movement from vehicles or people.) and vibration.
Habitats and flora	Construction and Operation	The following likely significant effects are expected on habitats as a result of the NWL. The effects will vary depending on the location and nature of the habitat, which will be assessed in the ES. Construction Phase Habitat loss: direct loss (including severance and fragmentation). Habitat degradation through pollution or reduction in air quality. Disturbance through lighting, noise, visual and vibration. Operation Phase Habitat degradation through pollution or reduction in air quality. Disturbance through lighting, noise, visual, vibration and trampling (due to NMU route improvements).
Fauna	Construction and Operation	The following likely significant effects are expected on fauna as a result of the NWL. The effects will vary depending on the type and distribution of fauna, which will be assessed in the ES. Construction Phase

Biodiversity Feature	Phase	Likely Significant Effect (in the Absence of Mitigation)
		Habitat loss: potential for direct loss of habitat supporting fauna. Potential effect on distribution and abundance. Severance / fragmentation of habitat: Potential to sever existing commuting routes and separate existing populations. General construction activities: Killing or injury. Habitat degradation through pollution or reduction in air quality: Reduced functionality of habitat supporting fauna. Disturbance through lighting, noise, visual and vibration: Potential effect on behaviour. <u>Operation Phase</u> Collision risk: Killing or injury. Habitat degradation through pollution or reduction in air quality: Reduced functionality of habitat supporting fauna. Disturbance through lighting, noise, visual and vibration: Potential effect on behaviour.

HABITATS REGULATIONS ASSESSMENT (HRA)

6.2.2. A Habitats Regulation Assessment (HRA) will be undertaken in accordance with the Conservation of Habitat and Species Regulations 2017 (as amended) to assess the effects of the NWL on Internationally Designated Sites, including the River Wensum SAC, which will be crossed by the NWL. The HRA will sit alongside the ES and will be submitted as part of the Planning Application. The HRA will follow the four-stage process, summarised as follow:

Stage 1

6.2.3. Identify whether it is likely that the Scheme, either alone or in combination with other projects, will have a likely significant effect on any Internationally Designated Sites such as the River Wensum SAC. The threshold is a very low one and the conclusion will be affirmative unless significant effects can be excluded on the basis of objective evidence.

Stage 2

6.2.4. If there is an affirmative conclusion at Stage 1, a Report to Inform Appropriate Assessment will be undertaken to assess the effect of the Scheme, either alone or in combination with other projects, on the integrity of any Internationally Designated Sites screened in at Stage 1 in view of its conservation objectives, to allow the planning decision maker to carry out the formal Appropriate Assessment process.

Stage 3

6.2.5. Where adverse effects on the integrity of any Internationally Designated Sites are identified, the planning decision maker will need to examine if alternative solutions to seek to avoid such impacts are available.

Stage 4

6.2.6. Where it is concluded under Stage 3 that no alternative solutions exist, and where adverse impacts on the integrity of any Internationally Designated Sites remain, the planning decision maker will assess whether the Scheme must be carried out for imperative reasons of over-riding public interest (IROPI) and, if so, whether compensatory measures needed to maintain the overall coherence of the Internationally Designated Site can be achieved.

6.3 POTENTIAL MITIGATION MEASURES AND ENHANCEMENT OPPORTUNITIES

WITHIN THE NWL BOUNDARY

6.3.1. As a priority, the NWL will consider all options to avoid potential adverse effects on biodiversity features by adhering to the mitigation hierarchy, where practicable, as follows:

- Avoidance/prevention: measures taken to avoid or prevent adverse effects, for example, the design of the viaduct crossing over the River Wensum SAC and SSSI, as well as timing vegetation clearance outside of the nesting bird season (March to August inclusive) where practicable (and with appropriate controls where this is not practicable);
- Reduction/mitigation measures taken to avoid or reduce adverse effects, for example retaining walls or pollution interceptors; and

- Compensation/offsetting: measures taken to offset significant residual adverse effects, such as those which cannot be entirely avoided or mitigated to the point that they become insignificant. For example, habitat creation, or enhancement.

6.3.2. The following habitats will be created within the NWL boundary to serve towards protected species mitigation, BNG, and arboriculture mitigation:

- Woodland and scrub planting;
- Standard tree planting;
- Hedgerow planting;
- Species-rich grassland planting; and
- Wetland vegetation.

6.3.3. Habitat creation within the NWL boundary will include measures to buffer and enhance retained habitat, such as scrub planting along newly created woodland edges. Habitat creation will also be used to augment existing vegetation connected to the green bridge and underpass crossing locations (identified later in this report) to strengthen and enhance habitat connectivity and maximise the effectiveness of these features. Habitat creation has also been designed to avoid attracting species such as bats, badgers, and barn owls towards the traffic corridor where there is a risk of injury and mortality through traffic collision. This will be achieved through strategic planting and offsetting certain habitat types away from the road (further details regarding habitat creation outside the NWL boundary are detailed later in this report).

6.3.4. Habitat severance and fragmentation by the NWL has been assessed to help ensure that species commuting and foraging across the existing landscape are appropriately mitigated for. Barbastelle bats are one of the key species located within the study area. Mitigation measures incorporated into the design includes green bridges, underpasses and landscape planting to maintain habitat permeability and to discourage bat activity within the traffic corridor. The most effective method of mitigation for bats across linear infrastructure includes a combination of well-designed green bridges and underpasses[25] alongside landscaped bat crossing where the road is in cutting and mitigation for the NWL focuses on these types of features. Bat gantries will not be considered as a mitigation feature for bats within the NWL.

6.3.5. It is important to note that, although the primary function of green bridges, underpasses and landscaped bat crossings are to maintain bat commuting routes, these crossing points will benefit other species that may be impacted by the NWL.

6.3.6. Underpasses suitable for use by badgers will also be incorporated into the NWL, to ensure that badgers can maintain their existing commuting routes. Badger fencing will be used, where appropriate, to ensure that they are guided to the safe crossing points, reducing collision risk.

[25] Berthinussen, A., & Altringham, J. (2015). WC1060 Development of a Cost-Effective Method for Monitoring the Effectiveness of Mitigation for Bats Crossing Linear Transport Infrastructure. Leeds.

6.3.7. Any culverts associated with watercourses included in the NWL design will be designed to allow fish passage as informed through survey work.

6.3.8. All species afforded legislative protection will be mitigated for through the appropriate Natural England licensing procedures. Where considered appropriate, this may involve the translocation of certain species in advance of construction phase to either adjacent or newly-created habitat.

6.3.9. During the construction phase there will be adherence to best practice pollution prevention guidelines, outlined by the Guidance for Pollution Prevention (GPP) series, with specific reference to GPP5: Works and maintenance in or near water (Natural Resources Wales (NRW) 2018[26]).

6.3.10. An Ecological Clerk of Works (ECoW) will be appointed during the construction phase, to ensure all ecological method statements are followed correctly, avoiding and/or minimising risk to biodiversity features. To avoid potential adverse effects upon protected species, their breeding and movement will be considered through specific mitigation measures. For example, timing of vegetation clearance will be planned to avoid periods such as the nesting bird season (March to August inclusive) where practicable or the sensitive lifecycle stages of the fish present (and with appropriate controls where this is not practicable).

6.3.11. All measures to protected biodiversity features during the construction phase will be incorporated within the OCEMP and included alongside the ES in the Planning Application.

6.3.12. Ecological mitigation for the NWL reported in this section will continue to be refined as assessment work continues for the ES.

Proposed Mitigation Locations

6.3.13. Proposed mitigation for the severance of bat commuting and foraging habitats includes underpasses landscaped bat crossing and green bridges in addition to the viaduct which allows continued movement of bats beneath. The design is informed by widely acknowledged bat mitigation principles and findings of a literature review. The approach of using bat crossings is supported by a review of bat mitigation measures[27] which states that '*Based on the evidence available at present, the best bat mitigation solution is a combination of underpasses and green bridges along the length of linear infrastructure, to maintain bat commuting routes and increase the permeability of the infrastructure*'.

6.3.14. The indicative locations of key proposed mitigation features; either crossing points or landscape proposals are shown in **Figure 6-1**, structures align to habitats most used by bats that are intersected by the NWL.

[26] Natural Resources Wales (2018). Guidance for Pollution Prevention: Works and maintenance in or near water: GPP5.

[27] Berthinussen, A., & Altringham, J. (2015). WC1060 Development of a Cost-Effective Method for Monitoring the Effectiveness of Mitigation for Bats Crossing Linear Transport Infrastructure. Leeds.

Figure 6-1 – Proposed Mitigation Locations

General Proposed Mitigation Specifications

6.3.15. The following technical specifications are informed by available literature and widely acknowledged best practice guidance relating to bat mitigation, and will be used to design the green bridges, underpasses and landscape planting.

6.3.16. The results of baseline bat surveys have informed the requirement for bat mitigation in particular locations and the design of mitigation proposed. Design aspects including the positioning, skew and dimensions of underpasses and green bridges have been fully considered in relation to this data. Green bridges will be a minimum 14.5m width (current design) and be positioned on existing bat flight lines to maintain habitat connectivity. The structures have been designed to allow landscape planting, to include as a minimum, hedgerow planting which spans the structure and connects to retained vegetation either side of the road.

6.3.17. Following refinement of the route alignment in the northern section of the scheme, the alignment now crosses the Nursery Woodland (part of the Northern Woodlands), The final design for mitigation in this location is currently subject to development, with options including a green bridge and landscape treatment under consideration and will be reported in the ES.

Underpasses

6.3.18. Proposed underpasses will conform to the following general specifications:

- Underpasses will be placed in the location of existing bat commuting routes, minimising the need for bats to alter their commuting flight lines;

- Underpasses will be a minimum of 4m height x 4m width (once topsoil and surfacing have been accounted for)[28] to increase the probability that barbastelle and other bat species will regularly use the crossings in preference to be flying above the Scheme;
- The 'wing walls' will be splayed to benefit bat movement at each end of the underpass and will funnel bats towards the tunnel entrance;
- Underpasses will not be artificially lit and a combination of fencing and/or vegetation planting along the edges of the underpass and behind the wing walls, will deflect light spill from the road and ensure that the route maintains a dark corridor;
- Landscape planting will be used to augment existing vegetation connected to the underpass locations, to strengthen and enhance bat commuting routes. New planting will be installed at the earliest opportunity to allow vegetation to become established. Planting stock will comprise native species of local provenance selected to provide sufficient height, and density to function as bat foraging and commuting habitat;
- Disturbance will be minimised during installation of underpasses, for example by:
  - Preventing nocturnal noise and light pollution along the bat flight path;
  - Minimising vegetation clearance and the time prior to replanting; and
  - Installing suitable temporary crossing features (such as container-grown trees and/or willow hurdle) during the construction phase to maintain habitat connectivity in advance of replanting.

6.3.19. Consideration will also be given to the seasonal timing of works; for example where practicable, undertaking the most substantial construction activities during the periods when bats are less active or less sensitive to disturbance.

Green Bridges

6.3.20. Proposed green bridges will conform to the following general specifications:

- Green bridges will be placed in the location of existing bat commuting routes, minimising the need for bats to alter their commuting flight lines or height;
- Bridge designs retain existing vegetation where possible, specifically established trees and shrubs, and incorporate planting to create a continuous band of shrub and tree planting between retained woodland/hedgerow areas either side of the Scheme. Planting will be located and specified to align with existing vegetation for continuity and to maintain ecological functionality;
- Green bridges will be planted with 'instant' native hedgerow (with a minimum target height of 2.5 metres) to provide immediate vegetation connectivity on installation. As a minimum this will include double hedgerows along the outer edges of the bridge, with each double hedgerow 3m in width. Shrubs will be planted along the inner face of the hedgerows to provide a varied and sheltered habitat for bats to commute along. Where designs permit, additional hedgerow and/or shrub planting will be included to increase structural diversity and the range of commuting habitat available to bats;
- Designs will allow sufficient substrate depth to allow vegetation to meet target dimensions, and appropriate drainage to avoid the need for artificial irrigation in the medium to longer term;

[28] in line with research conducted by Boonman, 2011.

- New planting will be installed at the earliest opportunity to allow vegetation to become established. Planting stock will comprise native species of local provenance selected to provide sufficient height, and density to function as bat foraging and commuting habitat;
- The bridges will not be lit and the designs will include measures to avoid light spill from the road below onto the bridge e.g. a closed parapet or close board fencing;
- Disturbance will be minimised during installation of green bridges, for example by:
  - Preventing nocturnal noise and light pollution along the bat flight path;
  - Minimising vegetation clearance and the time prior to replanting; and
  - Installing suitable temporary crossing features (such as container-grown trees and/or willow hurdle fencing) during the construction phase to maintain habitat connectivity in advance of replanting.
- Consideration will also be given to the seasonal timing of works; for example, where possible undertaking the most substantial construction activities during the periods when bats are less active or less sensitive to disturbance.

Landscape Planting to Influence Bat Activity

6.3.21. In two locations, Long Plantation and Gravelpit Plantation where the Scheme is in cutting, woodland retention and landscaping is designed to create safer opportunities for bats to fly above the traffic corridor. In both locations the Scheme severs woodland where bat activity has been recorded, however there is no clear single commuting route identifiable based on existing data. These locations have been selected because research data shows a positive correlation between road-crossing height and the height of the roadside embankment[29], this is reflected in recent monitoring data collected for the Broadland Northway where crossing height (above road) was found to be typically higher where the road was in cutting[30]. In combination, earthworks and landscape design (to include retention and planting) will seek to minimise the clearance width and create a physical obstruction to bat movement towards the road below 3-4m in height (above the road surface) to promote increased flight heights[31]. This may include increasing the height of embanked sections (such that the top is greater than 3m above road level) and/or include dense planting or fencing to obstruct lower-level flight paths. This will also function to minimise light spill into retained woodland and reduce disturbance through increased noise and vibration that might otherwise occur.

6.3.22. Landscape design is also an option under consideration at The Nursery Woodland, alongside the option to install a green bridge in this location.

[29] Berthinussen A, Altringham J (2012). *Do Bat Gantries and Underpasses Help Bats Cross Roads Safely?* Available online: https://doi.org/10.1371/journal.pone.0038775

[30] Mott Macdonald on behalf of NCC (2021). NDR Ecological Post-Construction Monitoring: Year Three, Bat Mitigation Monitoring. Available online: https://www.norfolk.gov.uk/-/media/norfolk/downloads/roads-and-transport/ndr/environmental-monitoring/ndr-post-construction-bat-monitoring-report--year-3-second-revision.pdf.

[31] Christensen, M et al (2016). CEDR Call 2013: Roads and Wildlife, SafeBatPaths Fumbling in the dark – effectiveness of bat mitigation measures on roads, Hop-overs and their effects on flight heights and patterns of commuting bats – a field experiment. Available online: https://www.cedr.eu/download/other_public_files/research_programme/call_2013/roads_and_wildlife/safebatpaths/Bat_mitigation_on_roads_A_field_experiment_of_hop_overs.pdf

LAND OUTSIDE THAT REQUIRED TO BUILD THE SCHEME

6.3.23. In addition to the mitigation immediately along the NWL outlined above in **Section 6.3.1**, mitigation and enhancement further from the road and will be provided as part of the NWL. This will be away from land needed to build the NWL but still be in close proximity to the alignment.

6.3.24. At this stage, the mitigation and enhancement proposals away from the NWL reported in this document are high level, due to the current stage of assessment, and will be further refined as the assessment and landowner discussions progress.

6.3.25. There are four drivers for habitat creation related to the NWL: protected species mitigation; arboriculture mitigation and enhancement; Water Framework Directive mitigation; and Biodiversity Net Gain. Habitat types required outside the land to build the Proposed Scheme:

- Woodland creation and enhancement – woodland creation will be achieved by planting a mix of deciduous, native broadleaved tree species, including young and more mature trees, as well as planting of native flora for the understory and edge habitat. Management will aim to encourage newly planted trees to remain free from competing vegetation and maintenance of fences and other protective features is likely to be required. Broadleaved woodland encourages fauna such as bats, badgers, and birds. Diversity in age and species of trees and plants is key to a healthy woodland and maximises the habitat to benefit prey species of the protected barbastelle bat (e.g. moths). Enhancement of existing woodland will also be achieved by additional planting, selective removal of some coniferous species, as well as repurposing of dead or felled trees as deadwood habitat. Woodland habitat provision for bat mitigation will be carefully located away from the NWL alignment to avoid future disturbance and other impacts during operation of the NWL.
- Scrub - scrub is a general term for shrubs such as wild privet, dogwood, buckthorn, and hawthorn, which are typically found between grassland or heath and woodland. A mixture of seedlings, saplings, young and mature shrubs would be included. Creation of scrub habitat limits soil erosion and helps capture water to reduce downstream flood risks and maintain water quality in streams and rivers. Scrub also supports species such as invertebrates, bats and birds. Having a mix of grassland, scrub and woodland gives a mosaic of habitats which increases species diversity and connectivity through the landscape.
- Hedgerow creation and enhancement - creation of hedgerows provides a new habitat for species such as hedgehogs, birds, and bats, and also improves connectivity for wildlife between existing habitats. Planting will comprise a mix of native species in staggered double rows with the inclusion of suitable species to develop into fully grown trees within the hedgerow. New hedgerows will be managed and replanted as necessary to limit gaps and to achieve a height of at least two metres and width of at least 1.5 metres. Enhancing existing hedgerows with additional planting will also improve the quality and diversity that these habitats already provide. Enhancement would include allowing hedgerows to grow wilder and larger, with relaxed management regimes.

- Grassland - grassland may constitute a large open area or strips of land covered with grass, commonly used for grazing. A native seed mix will be used, including wildflower species. Management will be required to limit areas of bare ground and encroachment of scrub and bramble. The diversity of plants and wildflower species present in grassland habitat attracts a variety of insects (including butterflies and bees) and arthropods (from spiders to millipedes). This, in turn, provides foraging habitat for predators including birds and mammals. Grassland for barn owl mitigation would be carefully located away from the NWL to avoid future disturbance and other impacts during operation of the NWL
- Ditch creation and enhancement – new wetland habitat will be created close to the River Wensum, with suitable vegetation to provide optimal habitat for water vole and Desmoulin's whorl snail. Existing ditches will also be enhanced through widening, and reconnecting channels, and translocating vegetation where possible. Adding fencing or extra-wide margins will also protect the ditches from cattle damage.

6.3.26. Local landowners are being approached to explore the opportunities within their land to implement habitat creation and enhancement.

BIODIVERSITY NET GAIN (BNG)

6.3.27. Delivery of a certain amount of created and/or enhanced habitat is required in order to reach a net gain in biodiversity units for specific habitat type post-construction, compared with the baseline. The current baseline conditions influence the habitat types and extents required to achieve net gain, with the general requirement to replace higher value habitats on a like-for-like-or-better basis. In practice this means that, for example, woodland removed to facilitate construction would be compensated by woodland creation, whereas the removal of scrub could be compensated by scrub creation, and/or creation of woodland habitat.

6.3.28. Habitats created along the NWL verges will contribute to the BNG target. Habitat requirements for species mitigation and other environmental mitigation, such as flood compensation, also contribute towards net gain therefore the total area required for each habitat type is determined by the requirement to incorporate appropriate environmental mitigation, compensation, and BNG.

6.3.29. The BNG calculations will be undertaken in line with the recently published (April 2022) Defra BNG 3.1 metric and also in line with the developing design.

6.3.30. Requirements for BNG may be satisfied either through habitat creation along the NWL verges and enhancement on nearby land further from the road or by other mechanisms, such as use of habitat banking where habitat provision is secured through third parties. A habitat bank is an area of land (outside of the development boundary) that is purposefully managed to increase its ecological value relative to the initial baseline. The uplift in biodiversity units this land generates can then be sold to developers who need additional units to demonstrate BNG. Habitat banks are operated by third parties, and may provide units to multiple clients (rather than a project specific habitat creation which only contributes to that schemes BNG target). These contribute to biodiversity net gain in the wider landscape.

ENVIRONMENTAL NET GAIN (ENG)

6.3.31. Environmental Net Gain (ENG) describes gains in ecosystem service provision (wider benefits such as flood management, air quality benefits and health) associated with the habitats provided to

achieve BNG. Norfolk County Council's environment policy embeds "an ‘environmental net gain’ principle for development, including housing and infrastructure".

6.3.32. To determine if ENG has been achieved, ecosystem services that are a local priority will be determined. The Natural England 'Environmental Benefits from Nature Tool' will then be used to identify the changes in ecosystem service provision associated with the habitats created and restored to achieve BNG. This tool will then identify where there has been quantifiable gains in ecosystem services, relative to the baseline.

7 ARBORICULTURE

7.1 BASELINE

7.1.1. Baseline arboriculture data has been collected from 2019 onwards. The area of assessment extended to a buffer of 15 metres beyond the NWL Boundary. Further baseline data will be obtained as necessary.

7.1.2. A desk-study[74] was undertaken to identify arboricultural features within the NWL Boundary plus a 15m buffer. There are no Tree Preservation Orders (TPOs) and conservation areas within the study area.

7.1.3. The Ancient Tree Inventory (ATI) was examined. Key characteristics of an ancient tree are a low, fat and squat shape; a wide trunk for the species of tree; hollowing of the trunk. A veteran tree shows those characteristics, but they may have arisen from other causes. A notable tree is a locally important specimen due to cultural associations or size. Natural England's MAGIC online map resource[32] to confirm no ancient woodland within the study area.

7.1.4. A comprehensive field survey was also undertaken by an arboricultural consultant, between December 2019 and February 2020, to capture data on all qualifying arboricultural features within the study area. BS 5837:2012 categorised arboricultural features based on their quality with Category A being the highest quality and including all ancient and veteran trees. A follow up survey was undertaken in March 2022 to cover additional areas related to the alignment refinement.

7.1.5. An additional survey explored whether woody plants forming hedgerows might qualify as veteran features. The assessment concluded that hedgerow plants did not qualify as ancient or veteran[33].

7.1.6. Within the survey area trees have been surveyed and classified under British Standard 5837 as Category A, B, C or U. Category A being high quality and U being very low quality. Within the study area veteran and ancient trees have also been identified. The tree constraints data is being assessed with the latest design to determine the arboricultural impacts of the scheme.

7.2 POTENTIAL IMPACTS

7.2.1. The NWL will result in impacts to arboricultural features, including the root protection zone of trees which may prevent the tree from being retained. This will include impacts to high quality features, some of which are irreplaceable ancient and veteran trees. Not all trees within the NWL Boundary will be impacted and retention of trees is the first priority. The ES will outline the impact on arboricultural features. At this time up to 12 Ancient or Veteran trees are potentially impacted.

7.2.2. Avoidance of areas of Ancient Woodland was a consideration in the route selection with no ancient woodlands in the NWL Boundary. As outlined in Section 2 Air Quality and Section 6 Biodiversity and assessment on ancient woodland habitat will be undertaken in the ES which will include potential impacts from air quality deterioration.

[32] Magic (DEFRA), 2018. *Multi Agency Geographic Information for the Countryside* [online] Available at: < https://magic.defra.gov.uk/MagicMap.aspx> [accessed, 27 February 2020].

[33] WSP (2021a) Norwich Western Link - Ancient Hedgerow Report. Cambridge

7.3 POTENTIAL MITIGATION MEASURES AND ENHANCEMENT OPPORTUNITIES

7.3.1. The design of mitigation planting will rely upon native tree and shrub species and follow good practice contained in the UK Forestry Standard[34]. Consultation with NCC tree officers will continue to refine mitigation proposals.

7.3.2. As far as reasonably practicable, the focus will be on retaining trees and avoiding the need to remove them. Where this is not possible, a compensation strategy will be developed within the ES.

7.3.3. Additional measures will be implemented where ancient and veteran trees are impacted and a strategy developed as part of the ES. Ancient and veteran trees which are sufficiently structurally sound for them to be relocated, will be salvaged as deadwood habitats

7.3.4. The potential compensation planting uses a measure of the area occupied by trees which will be based on the Root Protection Area (RPA). This means three-times the collective area of the RPAs of A category trees would be planted. Similarly, twice the area of moderate quality woodland lost would be reinstated with new woodland and the RPA of C category trees will be compensated on a like for like basis.

7.3.5. The RPA of tree groups and woodlands will be employed as the baseline for compensation in the same way. Locations additional to the land needed to build the NWL will be identified through consultation with local landowners and the area of required tree compensation will be confirmed in the ES.

7.3.6. Additional measures will be implemented where ancient and veteran trees are removed, and a strategy developed as part of the ES. Ancient and veteran trees which are sufficiently structurally sound will be salvaged as deadwood habitats.

[34] Forestry Commission (2017). The UK Forestry Standard. Forestry Commission, Edinburgh

8 ROAD DRAINAGE AND THE WATER ENVIRONMENT

8.1 BASELINE

8.1.1. A study area of 500m from the NWL Boundary has been applied to the assessment of surface water elements. Additionally, a study area of 1km from the NWL Boundary has been applied to the assessment of hydrogeological elements and Water Framework Directive (WFD) water bodies.

MAIN RIVERS

8.1.2. The River Wensum is a 'main river' (an EA designation) crossed by the NWL (**Figure 8-2**). It is a low gradient groundwater (chalk aquifer) dominated chalk stream. The catchment area (area of land that drains into a river) is 571 km^2.

8.1.3. The floodplain of the River Wensum in the study area comprises mainly of managed grassland with areas of fen, wet grassland, woodland and wet woodland. The floodplain has historically been drained for agricultural purposes by a series of drains.

8.1.4. The River Wensum in the vicinity of the NWL is designated under the WFD as a heavily modified waterbody and is currently achieving Moderate status[35] as defined by the WFD. The hydromorphological status classification for the River Wensum WFD water body is defined as 'Supports Good'. This means that the current natural forms and processes within the channel (erosion, transportation and deposition) are in a state that would support the WFD water body in achieving Good ecological potential by the target date set under the WFD. The hydrological regime as defined by the WFD is currently classified as 'Does Not Support Good' due to pressures and impacts within the wider catchment upon the hydrological regime.

8.1.5. The River Wensum is designated as a SSSI[36] in recognition of its chalky lowland river characteristics. The River Wensum is also a SAC[37]. Further baseline information is presented in **Section 6: Biodiversity**.

8.1.6. A walkover survey in November 2020 confirmed current conditions. The flow patterns in the river were mostly smooth. The riverbed substrate was predominantly fine to medium gravels and river banks capable of supporting a rich riparian (river side and banks) zone. However, the riparian zone was somewhat fragmented throughout the study area, with sections of both very high-quality and poorer quality riparian habitat. An updated survey will be undertaken in early summer 2022 to confirm conditions at the river crossing point.

8.1.7. No significant erosion was noted in the study area, however, discrete sections of bank appeared affected by livestock disturbance where no riverside buffer was present.

[35] Background to the WFD and its classifications can be found at the following links: https://ec.europa.eu/environment/water/water-framework/info/intro_en.htm https://environment.data.gov.uk/catchment-planning/help/usage#the-catchment-data-explorer

[36] Natural England- Designated Sites View Available online at: https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=S1006328&SiteName= [last accessed February 2020]

[37] Joint Nature Conservation Committee

OTHER SURFACE WATER FEATURES

8.1.8. The NWL crosses one unnamed ordinary watercourse (a river, stream etc not designated by the EA as a 'main watercourse') located between Honingham and Weston Green. This watercourse, Foxburrow Stream, is a tributary of the River Tud which is a 'main river'. A walkover survey of this watercourse, where the NWL intersects, was undertaken in June 2020 indicated that this watercourse has been subject to modification and ongoing management. The floodplain was actively grazed by cattle during the survey and disturbance of the banks was noted. A significant quantity of fine sediment (sand/silt) was observed over the gravel substrate during the survey.

8.1.9. The River Tud itself, a main river and tributary of the River Wensum, is located approximately 300m to the south of the southern extent of the NWL and is designated as heavily modified and is currently achieving Moderate status. The hydromorphological status 'Supports Good' and hydrological regime currently 'Supports Good'. The Foxburrow Stream is crossed by the NWL as outlined below (Other Surface Water Features).

8.1.10. The NWL crosses the location of two significant routes for overland water flow between Weston Road and Ringland Lane, believed to be temporary / seasonal ordinary watercourses, coinciding with the location of head deposits in this area and the alignment of an existing drain respectively. The flow paths discharge to the River Wensum.

8.1.11. There are numerous land drains and pond features within the floodplain of the River Wensum, most probably installed for agricultural land management purposes.

GROUNDWATER

8.1.12. The main characteristics of the geology that underlies the NWL are described in **Chapter 9: Geology and Soils**.

8.1.13. The NWL hydrogeology is dominated by White Chalk Subgroup, designated a Principal Aquifer[38], deemed capable of supporting water supplies at a regional scale. Principal aquifers may support water supply and/or river baseflow on a strategic scale[39].

8.1.14. The study area is identified as an area that can transmit pollution to groundwater easily, with the risk of affecting the underlying White Chalk Subgroup (Principal Aquifer).

8.1.15. The NWL Boundary is located within a Groundwater Source Protection Zone (SPZ3), meaning the underlying bedrock aquifer contributes groundwater flow towards a major groundwater abstraction point.

8.1.16. It is assumed that groundwater in strata above and within the Chalk contributes to the water levels and flows of both the River Wensum and the River Tud, this will be evaluated further at ES stage through detailed hydrogeological assessments.

8.1.17. Groundwater abstraction data has been provided by the EA and there are 31 private abstraction boreholes within 1km of the NWL, but no public water supplies within the NWL Boundary.

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[38] DEFRA (2021). Aquifer Designations and Groundwater Vulnerability Zones. Available at: https://magic.defra.gov.uk/MagicMap.aspx [Last accessed 08/07/2021]

[39] Environment Agency (2020). Aquifer Designations. Available at: http://apps.environment-agency.gov.uk/wiyby/117020.aspx [Last accessed 08/07/2021]

FLOOD RISK

Fluvial Flood Risk

8.1.18. The majority of the NWL alignment is located in the low-risk Flood Zone 1 where the risk of flooding from rivers is less than 1 in 1000 (0.1%) in any year (**Appendix A – Figure 1**). However, the NWL does include sections located in the medium risk Flood Zone 2, where the risk of fluvial flooding is between 1 in 1000 (0.1%) and 1 in 100 (1%) in any year, and the high-risk Flood Zone 3, where there is a greater than a 1 in 100 (1%) risk of fluvial flooding in any year, associated with the River Wensum and the Foxburrow Stream.

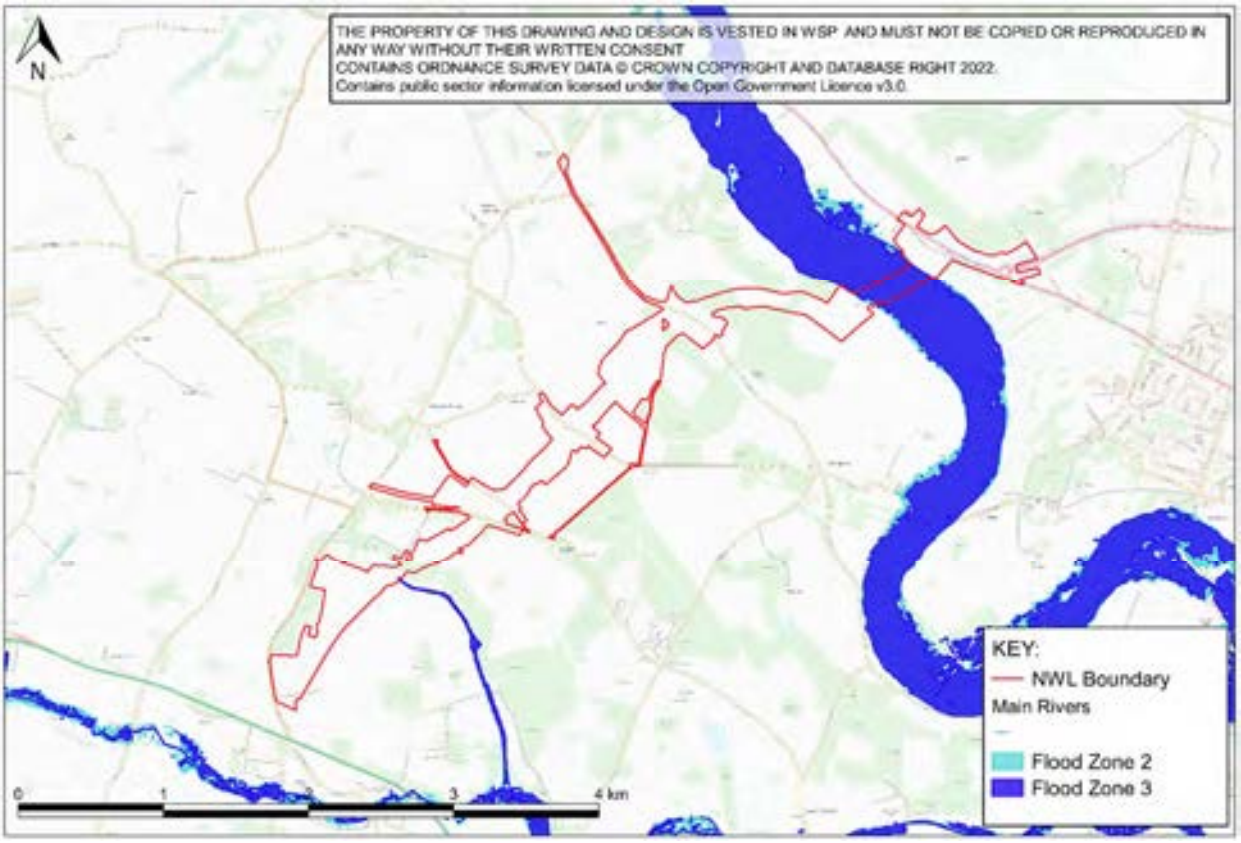

Figure 8-1 – Flood Map for Planning in Location of the NWL

8.1.19. Flooding from the River Wensum in the vicinity of the NWL is largely confined to the surrounding rural floodplain and open green space. There are a number of receptors within the wider area as well as other isolated properties in the river floodplain study area.

8.1.20. A flood model will be agreed with the EA and form the basis of the ES flood risk assessment and will incorporate known changes to the river from third party river improvement schemes and proposals for the River Wensum based on the EA's flood model of the Upper Wensum.

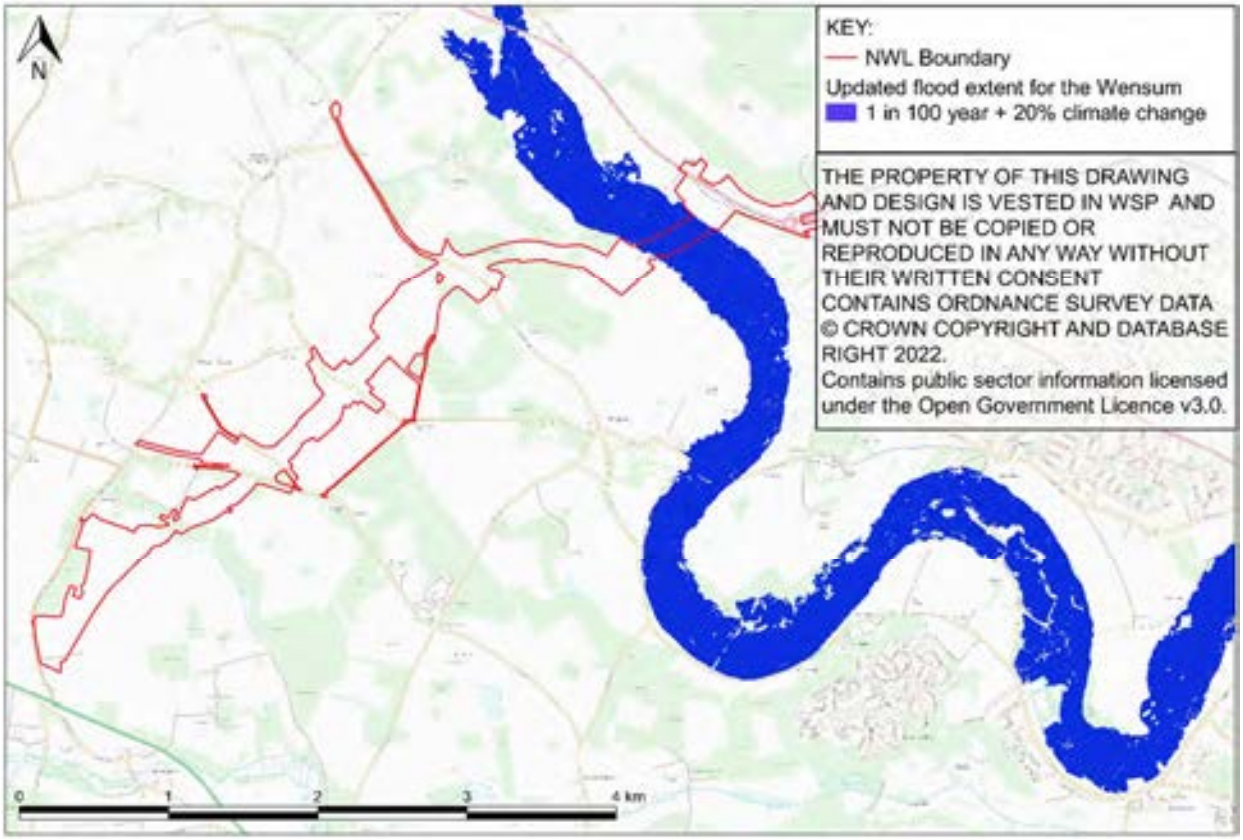

Figure 8-2 – Updated Flood Extent for the River Wensum, for 1 in 100 Year Flood Event, with 20% Climate Change Allowance

Surface Water Flood Risk

8.1.21. Review of the EA Flood Risk from Surface Water map[40] indicates that sections of the NWL are at high, medium and low risk of flooding from surface water sources.

8.1.22. In the study area, areas at risk of surface water flooding appear limited to fluvial flow associated with watercourses and drainage ditches. This indicates that fluvial flood flows will broadly remain within the channels of the watercourses.

[40] Long Term Flood Risk Map. Available online at: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map [last accessed June 2021]

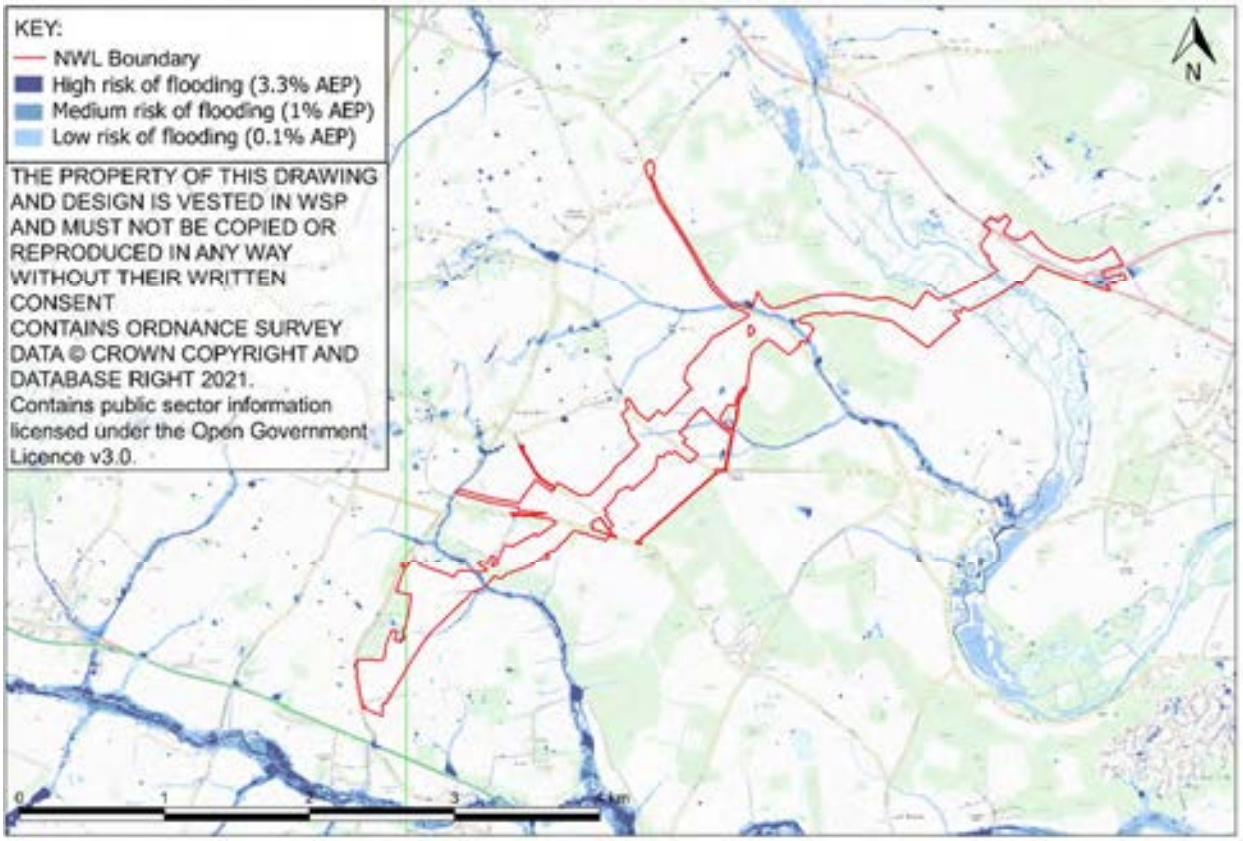

Figure 8-3 – Risk of Flooding from Surface Water in Location of the NWL

Flood Risk from Sewers

8.1.23. The NWL is a new road through mostly arable land and the existing flood risk from sewers is very low. There are foul sewers along Fakenham Road to the north of the NWL so sewer flood risk is higher in this location.

8.1.24. The Greater Norwich Level 2 Strategic Flood Risk Assessment does not identify any historic cases of flooding from sewers or water mains in the vicinity of the NWL.

Risk from Reservoir Failure

8.1.25. There is reservoir flood risk in the study area. The reservoir is Haveringland Lake situated on Trout Stream. The impact of a reservoir breach has largely dissipated at the location of the proposed scheme. Furthermore, it is assumed that these reservoirs are regularly inspected and essential safety work is carried out in line with current legislation. Therefore, the risk from reservoir flooding is considered to be low.

Groundwater Flood Risk

8.1.26. Groundwater flooding is expected to contribute to flood risk in the River Wensum valley as a result of groundwater discharges from the underlying aquifers when the groundwater levels are high. Groundwater levels are generally deep across most of the NWL so risk of groundwater flooding is very low.

FUTURE BASELINE

Surface Water

8.1.27. It is expected that there will be notable changes between current and future baseline for surface water features, namely the River Wensum, due to ongoing restoration work led by the River Wensum Restoration Strategy (RWRS)[41]. These potential future changes would be beneficial to the fluvial and ecological functioning of the river and floodplain system.

8.1.28. The aim of the RWRS is to restore functionality to sustain wildlife and fisheries characteristic of a chalk stream. Work is set to be completed by 2027.

The EA has advised that river restoration works are proposed at Taverham Mill on the River Wensum by Anglian Water[41]. The nature of the works is yet to be finalised; however, the general aim is to either reduce or remove the impoundment at the mill and restore in-channel habitat diversity for the section of channel upstream.

Groundwater

8.1.29. Climate change may affect groundwater levels of the shallow aquifers but the high storage capacity of the superficial deposits should buffer such changes.

Flood Risk

8.1.30. Flood risk is expected to increase with climate change. It is unlikely that the future baseline will be significantly different to current baseline for the majority of the NWL within Flood Zone 1. Hydraulic modelling provided by the EA indicates a likely increase in flood depth. In addition, the climate change allowances in the EA's guidance for Flood Risk Assessments[42] were updated by the Environment Agency in July 2021. The flood risk extents used to inform the design will be updated as part of the assessment to reflect this.

8.1.31. Peak rainfall intensity is also predicted to increase up to 40% in small catchments over the next 60 years (2080's) due to climate change in line with EA Guidance[42], impacting on surface water flooding and groundwater flooding due to increased runoff, rising groundwater levels and reduced soil permeability due to ground saturation.

8.2 POTENTIAL IMPACTS

8.2.1. Potential impacts from the NWL during the construction and operation phase are set out below (excluding impacts to flood risk from reservoirs and sewers which are not expected as a result of the NWL). These potential risks will be subject to further environmental assessment. Mitigation will be required should a significant effect be identified and with potential mitigation options presented in **Section 8.3**.

CONSTRUCTION

8.2.2. During construction, potential impacts (prior to mitigation) to surface water features, groundwater features and flood risk could arise from:

[41] River Wensum Restoration Strategy. Available online at: http://publications.naturalengland.org.uk/publication/43006 [last accessed June 2021]

[43] BGS, Geology of Britain viewer, accessed at https://www.bgs.ac.uk/map-viewers/geology-of-britain-viewer/.

- Increased risk of pollution of surface water and groundwater features from accidental spillages from site work or site compounds;
- Watercourses may be at risk of increased sedimentation from surface water runoff;
- Temporary structures required within the floodplain, watercourse channels are likely to cause a temporary change to flow dynamics which may affect sediment transport, deposition and erosion;
- Road cuttings and potential dewatering activities are proposed along the NWL during excavation to allow for below ground structures, road cuttings and attenuation basins which may be required. Groundwater dewatering can impact local groundwater receptors, hydraulically connected surface water features and ecological habitats;
- Construction activities require soil stripping and excavation, removing or reducing the protective cap on groundwater aquifers which may increase groundwater quality vulnerability;
- Construction in the floodplain of the River Wensum could result in a decreased capacity of the floodplain to store flood water and impede flood flow and may increase flood risk elsewhere. A temporary increase in impermeable surfacing, and compaction of ground, could also increase the rate and volume of surface water runoff; and
- Groundwater flooding occurring as a result of below ground structures which could potentially result in groundwater level rise to the NWL Boundary.

8.2.3. Each potential impact above will be assessed in the environmental statement and, where adverse effects cannot be avoided, appropriate mitigation measures will be recommended. **Section 8.3** below considers in more detail the mitigation measures currently being considered, pending the completion of the Environmental Statement.

OPERATION

8.2.4. During operation, potential impacts to surface water features, groundwater features and flood risk could arise from:

- A broad range of potential pollutants, accumulating on road surfaces. These can subsequently be washed off the road during rainfall, polluting the receiving water bodies. Uncontrolled discharge via ground infiltration can also cause permanent deterioration of groundwater quality;
- Introducing structures such as culverts into a watercourse may remove natural bed substrate and bank-side habitat and change flow dynamics and sediment transport increasing sediment deposition or erosion and introducing barriers to fish migration or mammal movement. Realigning watercourses may adversely impact natural bed substrates and habitats, with further risk of scour and erosion as the watercourse re-establishes;
- Structures such as viaducts and culverts may introduce shading on watercourses, impacting on ecology with an indirect impact through reducing channel roughness and locally increasing flow velocity and sediment transportation. Impacts from viaduct shading would be temporary whilst the shaded reach is recolonised by shade tolerant species;
- Linear structures such as highways can interrupt natural water flow paths and change catchment hydrology, impacting upon surface water features, as well as potentially posing increased flood risk;

- Permanent groundwater drainage may be required during the operational phase. The construction could alter local groundwater flow and levels, increasing flows in some catchments with associated reductions elsewhere. Groundwater drainage can impact upon local groundwater receptors, hydraulically connected surface water features and ecological habitats;
- Construction in the floodplain of the River Wensum could result in a permanent loss of capacity in the floodplain to store floodwater and impede flood flow conveyance which may significantly increase flood risk elsewhere. The proposed crossing of other ordinary watercourses and overland flow paths may also cause a localised increase in flood risk to adjacent land, including risks to flow velocity through proposed culverts;
- Groundwater flooding is expected to contribute to flood issues in the River Wensum valley. Below ground structures (e.g. bridge foundations) could act as flow barriers causing additional groundwater level rise; and
- The introduction of impermeable surface area within the study area may lead to an increase in the rate and volume of surface water runoff from the NWL, resulting in increased flood risk and reduced groundwater recharge.

8.2.5. Each of the potential impacts above will be assessed in the environmental statement and, where adverse effects cannot be avoided, appropriate mitigation measures will be recommended. **Section 8.3** below considers in more detail the mitigation measures currently being considered, pending the completion of the Environmental Statement.

8.3 POTENTIAL MITIGATION MEASURES AND ENHANCEMENT OPPORTUNITIES

CONSTRUCTION

8.3.1. An OCEMP will be prepared for the Planning Application and updated prior to construction by the appointed Contractor, to include method statements for the proposed works.

8.3.2. All construction works will be undertaken in line with best practice guidance including pollution prevention guidelines. Typical measures include sediment and pollution control by safe storage of materials, emergency response plans for spillages, re-fuelling of construction machinery within bunded areas, control of runoff and treatment of any polluted water prior to discharge and other similar techniques. These best practice methods would reduce the potential construction phase impacts listed in **Section 8.2** to an insignificant level.

OPERATION

Drainage

8.3.3. Surface water runoff from the NWL would be treated prior to discharge to groundwater and surface water bodies. Several treatment measures would be put in place to ensure that there is an acceptably low level of sediments and dissolved metals. The rate of discharge of highways drainage to receiving watercourses would be controlled so that surface water flood risk is not increased downstream of the NWL. Locally, groundwater drainage may be required if groundwater level rise is expected due to below ground structures forming groundwater flow barriers. A Drainage Strategy will be submitted as part of the Planning Application.

River Mitigation

8.3.4. It is considered that mitigation and enhancement through localised river improvements may be required within the floodplain of the River Wensum and Foxburrow Stream, to offset the potential impacts to these receptors arising due to the culverting of the Foxburrow Stream, the floodplain piers and channel shading due to the viaduct over the River Wensum, culverting of watercourses within the floodplain of the River Wensum and permanent access for maintenance. The extent of mitigation and enhancement required is subject to further WFD and BNG Rivers and Streams assessment and also subject to ongoing landowner negotiations.

8.3.5. Enhancements to off-set the potential impacts of the culvert on the Foxburrow Stream are in development on the same watercourse to both neutralise the impacts and provide 10% net gain for Rivers and Streams for BNG.

8.3.6. Enhancements to off-set the potential impacts of the viaduct, permanent access and culverting of minor watercourses within the floodplain of the River Wensum are in development. Mitigation and enhancement may include aquatic and riparian planting, reduction of pressures, such as livestock poaching of the river banks, gravel augmentation and floodplain scrapes.

8.3.7. Potential impacts from shading would likely be resolved through natural adjustment and recovery in the near term, with aquatic macrophytes recolonising the river bed following any disturbance due to construction impact shading. Should shading from the viaduct result in unsuitable habitats for shade intolerant species, it is anticipated that shade tolerant macrophytes would colonise. Potential impacts will also be mitigated as plans are developed for enhancements to deliver off-setting and net gain for BNG Rivers and Streams.

Flood Compensatory Storage

8.3.8. Pending results of the flood modelling work, the NWL may require mitigation to increase capacity to store flood water. The flood model would define the volume of flood storage required. The flood compensatory storage is still ongoing and the proposed area will be included within the formal planning application submission. The flood risk assessment will consider the impacts of both permanent and temporary works on the floodplains to ensure water can still naturally collect here. To reduce the risk of flooding caused by the addition of structures in the floodplain, such as viaduct columns, additional areas of the floodplain will be created to allow water to safely collect elsewhere. This will ensure that there is no increased risk of flooding.

Multi-Purpose Environmental Barrier

8.3.9. The current proposals for the River Wensum viaduct include a multi-purpose environmental barrier on the outer edges which has potential to provide benefits to the surrounding water environment. Its effectiveness in providing potential water environment benefits will be considered in the ES alongside the other environmental factors.

9 GEOLOGY AND SOILS

9.1 BASELINE

DESK STUDY

9.1.1. A desk study has been undertaken to determine potential sources of contamination in the NWL Boundary for consideration in the assessment.

SITE VISIT AND SURVEYS

Surrounding Area

9.1.2. The surrounding area is predominantly agricultural or wooded land with occasional residential properties and farm buildings. Multiple villages are also present within the vicinity of the NWL. Further afield to the east lie more densely populated residential areas on the western fringe of Norwich.

HISTORICAL SITE USES

9.1.3. A review of historical maps since 1882 has been undertaken to assess the historical land uses within the NWL and surrounding area (up to 250m).

9.1.4. Historical mapping from 1882 shows the area surrounding the NWL to have generally comprised agricultural land, plantations with roads and access tracks and has remained relatively unchanged. However, multiple clay and marl pit, ponds, plant nurseries and properties associated are within 250m of NWL.

GEOLOGY

9.1.5. The British Geological Survey (BGS) 'Geology of Britain' online viewer[43] and BGS maps of Aylsham and Norwich were reviewed. The geology underlying the NWL is summarised in **Table 9-1**. This outlines the various different geological units underlying the NWL Boundary, superficial and bedrock.

Table 9-1 – Summary of Geology

Superficial or Bedrock	Strata	Distribution Across the NWL
Superficial	Alluvium	Present in a band in the north of the NWL in the vicinity of the A1067
	Head Deposits	Present to the south of the alluvium deposits in the north of the NWL.
	River Terrace Deposits	Present to the north of the alluvium deposits in the north of the NWL.
	Sheringham Cliffs Formation	Dominates the superficial deposits for the majority of the NWL.
	Lowestoft Formation	Present only at the very south of the NWL in the vicinity of the A47.
	Table continues on next page	

[43] BGS, Geology of Britain viewer, accessed at https://www.bgs.ac.uk/map-viewers/geology-of-britain-viewer/.

Superficial or Bedrock	Strata	Distribution Across the NWL
	Happisburgh Glacigenic Formation	Potentially present in localised areas across the NWL.
Bedrock	Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation (Undifferentiated)	The unit underlies the entire NWL.

Water Bodies

9.1.6. Details of surface water and groundwater receptors in **Section 8.1** of **Chapter 8** of this Report.

AGRICULTURAL SOILS

9.1.7. Only pre-1988 Provisional Agricultural Land Classification Grade mapping is available for the NWL. Agricultural land is classified into five grades (Grade one is best quality and grade five is poorest quality). Based upon this mapping, agricultural soils within the NWL and surrounding area are classified as Grade 3 and 4.

ENVIRONMENTALLY SENSITIVE SITES

9.1.8. The entire NWL is located within a surface water and groundwater Nitrate Vulnerable Zone (NVZ), designated as being at risk from agricultural nitrate pollution. Part of the route crosses the River Wensum SSSI and SAC.

UNEXPLODED ORDNANCE (UXO)

9.1.9. Due to the proximity to a former airfield (RAF Attlebridge) to the north-west of the NWL, the Scheme will consider Unexploded Ordinance (UXO) threat and risk. The principal contractor will manage the scheme's UXO risk as part of detailed design and through the construction phase.

POTENTIAL SOURCES OF CONTAMINATION

9.1.10. **Table** 9-2 provides a summary of the potential sources of contamination that may be present within the NWL Boundary.

Table 9-2 – Potential Sources of Contamination

Potential Source	Potential Contaminants of Concern	Likely / Anticipated Distribution
On Site		
Potential Made Ground	Range of contaminants including metals, inorganics (e.g. cyanide), petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), ground gas (methane and carbon dioxide) and asbestos.	In discrete areas across the NWL Boundary.
Potentially infilled land	Ground gas (carbon dioxide and methane), PAHs, heavy metals, petroleum, hydrocarbons and asbestos.	Northern NWL extent
Agricultural Practices	Fertilisers and pesticides.	Site wide across the NWL Boundary
Plantations	Fertilisers and pesticides.	Multiple locations site wide across the NWL Boundary.
Historical Nursery	Fertilisers and pesticides.	Central areas of the NWL Boundary.
Off Site		
Potential Made Ground	Range of contaminants including metals, inorganics (e.g. cyanide), petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), ground gas (methane and carbon dioxide) and asbestos.	Predominantly in the northern areas of NWL Boundary.
Agricultural Practices	Fertilisers and pesticides.	Surrounding the NWL Boundary
Plantations	Fertilisers and pesticides.	All directions. Surrounding the NWL Boundary
Historically in-filled Clay and Marl Pits and Attlebridge Landfill	Ground gas (carbon dioxide and methane), PAHs, heavy metals, petroleum, hydrocarbons and asbestos.	Multiple locations around the north of the NWL Boundary.

SENSITIVE RECEPTORS

9.1.11. The following sensitive receptors have been identified for assessment in the ES:

Human Health

- Future road users of the NWL;
- Construction workers during the construction the NWL and road maintenance workers in operation; and
- Third party neighbours – people using adjacent land.

Controlled Waters

- Groundwater including the nearby principal aquifers; and
- River Wensum, its associated floodplains and unnamed water features across the study area.

Other

- Agricultural soils.

9.2 POTENTIAL IMPACTS

9.2.1. A number of receptors were identified. **Section 9.3** provides potential mitigation for these effects. Potential impacts will be assessed as part of the ES.

CONSTRUCTION IMPACTS AND EFFECTS

- Potential effect to human health for construction workers and third-party neighbours from potential contamination within the underlying soils/groundwater (if present);
- Potential chemical effects on agricultural soils; and
- Potential chemical effect to Controlled Waters.

OPERATIONAL IMPACTS AND EFFECTS

Insignificant Effects

9.2.2. Any contamination identified during construction will be remediated within the construction phase. Any material used for the top earth layers will be tested and verified for depth and chemical quality prior to use. No potential impacts during operation of the NWL are considered likely.

9.3 POTENTIAL MITIGATION MEASURES AND ENHANCEMENT OPPORTUNITIES

9.3.1. The National Planning Policy Framework (NPPF) requires the NWL to be 'suitable for use' in relation to ground contamination before the NWL become operational. Therefore, should contamination be present, the development of the NWL would provide a beneficial effect through remediation works.

9.3.2. An OCEMP will be prepared for the Planning Application and updated prior to construction by the appointed Contractor, to include method statements for the proposed works.

In addition, the following is anticipated to address both construction and operational effects:

- Further UXO risk assessment;
- Ground investigation and related contamination risk assessments;
- Remediation Strategy (if required); and
- Permanent controlled drainage to manage surface water runoff associated with the NWL.

9.3.3. Any additional mitigation measures will be identified in the ES.

10 MATERIALS AND WASTE

10.1 INTRODUCTION

10.1.1. This chapter outlines the basic baseline information and potential impacts of the NWL Scheme on the consumption of materials and the disposal of waste. It also gives an overview of the exiting Materials and Waste data relating to the Scheme in its current state.

10.1.2. A section on the potential impacts and mitigation measures for the scheme is also provided based on, limited data available for assessment.

10.2 BASELINE

10.2.1. This section describes the baseline material consumption and waste disposal for the existing land use, where the scheme is not yet built. This baseline data provides local/national information and data in the context of which the ES will be undertaken.

10.2.2. Baseline data for Material Assets and Waste requires the collection and review of the following information:

- The general availability (production, stock, sales) of material resources within the south east of England (or nationally, as available);
- The availability of landfill capacity within the south east of England; and
- The availability of infrastructure in the south east of England to transfer and recover construction, demolition and excavation (CDE) wastes from the NWL.

10.2.3. The current land use consists of agricultural fields intersected by small areas of woodland, hedgerows, drainage channels from the River Wensum, and single lane carriageways.

MATERIAL RESOURCES

10.2.4. This section outlines the current availability of materials at a regional level (East of England) which is considered when a scheme of this size and nature is undertaken.

Regional Perspective: Availability of Construction Materials

10.2.5. The sensitivity of materials required to construct the NWL is assessed to be low. Supply of construction materials may be temporarily inhibited by the current supply chain issues being experienced in the UK. The East of England is noted to have set a regional recycled content target for aggregate of 31% that is higher than the average for England (25%)[44].

Site Arisings

10.2.6. Site Arisings are materials derived from the construction and operation of a Scheme. In the case of the current land use, this applies to operational site arisings of the area within the Scheme boundary.

[44] Department for Communities and Local Government (2009). National and regional guidelines for aggregates
provision in England 2005-2020 [link]

Site Arisings Currently Generated

10.2.7. Negligible volumes of site arisings are expected from the current land use. These are limited to potential earthworks on the current agricultural land.

Transfer, Recovery and Recycling

10.2.8. The availability of materials recovery infrastructure in the East of England, suggests that there is strong potential to divert from landfill materials generated by the NWL, if they are not already used on-site or another local project. There is also potential to maximise the re-use / recycling value of site arisings, and materially influence the assessment of materials and waste.

Waste Generation and Disposal

10.2.9. This section provides context to NWL in the likelihood that the scheme will generate waste and the availability of landfill capacity for its disposal.

Waste Currently Generated and Disposed Of

10.2.10. The current land use within the NWL Scheme boundary is not expected to generate significant quantities of waste. Therefore, the anticipated impact of disposing of waste is deemed negligible.

Regional Perspective: Remaining Landfill Capacity

10.2.11. Baseline data indicates that in the absence of future provision, inert, non-inert and total landfill capacity may become an increasingly sensitive receptor throughout the construction phase and first full year of operation of the Scheme. Waste capacity in the East of England is forecast to reduce by up to 22% (inert) from a capacity of 21,921 m^3, 73% (non-inert) from a capacity of 27,275 m^3, and 29% (total) from a capacity of 50,446 m^3 from 2019 to 2025, in the absence of future provision.

10.2.12. Inert Landfill waste is waste that is neither chemically nor biologically reactive and will not decompose (or only very slowly). Non-inert Landfill waste is waste which can be broken down (decompose) organically e.g. bamboo, timber, vegetation, and other organic materials

10.3 POTENTIAL IMPACTS

10.3.1. The following construction and operational phase effects will be considered within the ES:

- The consumption of materials could have a potentially significant adverse effect through depletion of natural resources;
- The generation and disposal of waste generated by the NWL; and
- Regional landfill capacity.

10.3.2. The ES will set out the expected quantities of materials, arisings generated and assumptions in relation to their treatment in the waste hierarchy on a reasonable worst-case basis to assess the potential for significant adverse effects.

10.3.3. Potential Impacts relate to remediation and preparation, demolition, construction of the NWL and operation and maintenance.

10.4 POTENTIAL MITIGATION MEASURES AND ENHANCEMENT OPPORTUNITIES

10.4.1. Specific measures to mitigate adverse impacts from material resources consumption, and the generation and disposal of waste, will be identified and adopted during the ES. Examples of which are outlined below:

Materials

- Identification and specification of material resources that can be acquired responsibly;
- Design for optimising resources: simplifying layout, using standard sizes, balancing materials use cut and fill, and maximising the use of renewable materials, and materials with recycled or secondary content;
- Design for off-site construction: maximising the use of pre-made structures and components, encouraging a process of assembly rather than construction;
- Design for the future: considering how materials can be designed to be more easily adapted over the lifetime of a project and how easy it is to deconstruct at the end of the products life;
- Identifying opportunities to minimise both the export and import of material resources; and
- As part of a CEMP, implement a Materials Management Plan showing compliance with Environment Agency regulations for excavated ground materials (or Earthworks).

Waste

- Design for recovery and reuse: identifying, securing and using material resources at their highest value;
- Ensure arisings are properly characterised to maximise the potential for highest value reuse;
- Forecast and identify the volume and type of woodland and other vegetative arisings that will be generated and establish opportunities for high-value re-use and recycling;
- Ensuring arisings generated are handled, stored, managed and re-used or recycled as close as possible to the point of origin;
- Identify areas for stockpiling and storing wastes to minimise damage and loss; and
- As part of a CEMP capture information and data, by developing a site waste management plan.

11 GREENHOUSE GASES

11.1 BASELINE

11.1.1. The greenhouse gas (GHG) assessment will assess any increase or decrease in emissions as a result of the NWL, including:

- Construction emissions from the NWL and related transport of materials to and from the NWL and their manufacture; and
- Operational emissions resulting from the operation of the NWL and any shifts in transport modes/patterns.

11.1.2. GHG emissions occur as a result of human and natural activity. The GHG ES assessment will only consider instances in which the NWL results in additional or avoided emissions in comparison to the current situation (baseline) and any changes that would occur irrespective of the NWL. The baseline conditions focus on those emissions sources subject to change between the baseline scenario and the scenario with the NWL.

11.1.3. The baseline scenario where the NWL is not built involves no construction activities and therefore the construction baseline is zero emissions.

11.1.4. The operation and management of existing infrastructure in the study area (affected road network) is considered to result in minimal emissions.

11.1.5. The total end-user operational GHG emissions from traffic flows in the 'do nothing' scenario is modelled in accordance with the DMRB LA 114 Climate45.. The modelling includes the total GHG emissions for vehicles covered by the traffic model, covering the road network in the area of the Scheme and its surroundings. At present, this data for the end-user emissions is not available for inclusion but this data will be reported in the next stage of climate assessment in the ES.

11.2 POTENTIAL IMPACTS

11.2.1. The impacts of GHG emissions are global and cumulative in nature, with every tonne of GHG contributing to impacts on natural and human systems. The magnitude of emissions associated with the NWL will be quantified in the ES which will form part of the planning application for the NWL.

11.2.2. Following further work assessing the scheme as part of the Outline Business Case approvals process, modelling provides a range of carbon reduction from 277,000 tCO2e, to 450,000 tCO2e over the 60 year appraisal period, supporting local and national carbon reduction targets. The total amount of carbon emitted during the construction of the NWL, based on an initial assessment of quantities of materials required to construct the NWL, is likely to be in the order of 100,000 tCO2e. On the basis of this analysis, when considering both construction and operation, it is expected the NWL will be beneficial in achieving reductions in carbon emissions ranging from 177,000 tCO2e, to 350,000 tCO2e, supporting national and regional policy. The range presented is subject to further assessment and will be quantified and reported in the Environmental Statement that will be produced to support the planning application submission.

[45] Highways England (2021) DMRB LA 114 Climate http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/LA%20114%20Climate-web.pdf [Accessed 15/01/2020].

11.2.3. The GHG process for assessing emissions follows the references of PAS 2080:2016 Carbon Management in Infrastructure[46]. Potential sources of GHG emissions associated with the NWL that will be considered further in the ES are identified in **Table 11-1** (determined using guidance from the Institute of Environmental Management and Assessment (IEMA)[47], DMRB LA114 professional judgement and the scoping opinion).

Table 11-1 – Key Emissions Sources to be Considered within the ES

Element	Justification
Product stage (manufacture and transport of raw materials to suppliers)	Raw materials required for the NWL will result in embodied emissions; which may potentially be large
Transport of materials to the NWL	Construction stage emissions from fuel / energy consumption (specifically due to the delivery of material to the NWL) have the potential to be large.
Machinery and equipment used during construction	Fuel / energy consumption during construction would generate GHG emissions.
Replacement and refurbishment	Emissions associated with the NWL are potentially large.
End-user emissions (regional traffic flows) - traffic	Changes to regional traffic flows are expected with the potential for a large change in GHG emissions.

11.2.4. The approach to the GHG assessment will consider the GHG emissions (or avoided emissions) through a comparison of the baseline scenario without the NWL and the scenario with the NWL. The assessment will include the following:

- Collection of available data/information on the scale of GHG emitting activities for the baseline scenario and for the NWL. In each case this will cover the whole study period; and
- Calculation of the GHG emissions by applying a suitable emissions factor (tCO2e per unit of emissions generating activity).

11.3 POTENTIAL MITIGATION MEASURES AND ENHANCEMENT OPPORTUNITIES

CONSTRUCTION STAGE

11.3.1. Potential measures will be explored as part of the ES to minimise the magnitude of GHG emissions associated with the construction phase of the NWL, including:

- Minimising the quantities of materials required;
- Maximising the use of construction materials and products with recycled or secondary and low carbon content and from renewable sources;
- Using locally sourced materials where available and practicable;

[46] BSI. (2016). PAS 2080: Carbon Management in Infrastructure
[47] IEMA (2017) Assessing Greenhouse Gas Emissions and Evaluating their Significance https://www.iema.net/assets/newbuild/documents/IEMA%20GHG%20in%20EIA%20Guidance%20Document%20V4.pdf

- Using more efficient construction machinery and delivery vehicles; and
- Using innovative construction methods to reduce machinery use.

11.3.2. The mitigation measures required will be determined during the environmental assessment and design development.

OPERATIONAL STAGE

11.3.3. Potential measures will be explored as part of the ES to minimise the magnitude of GHG emissions associated with the operational phase of the NWL, including:

- Designing, specifying and constructing the NWL with a view to maximising the operational lifespan and minimising the need for maintenance and refurbishment;
- Designing, specifying and constructing the NWL with a view to maximising the potential for circular recovery (for example, reuse and recycling) of materials/elements at the end-of-life stage;
- Specifying high efficiency mechanical and electrical equipment such as telecoms; and
- Tree planting to increase carbon sequestration and offset operational GHG emissions.

12 CLIMATE RESILIENCE

12.1.1. Historic climate data has been extracted for the NWL location using Met Office Regional climate profiles[48] and weather station data. Future projected climate change data has been interpreted from UK Climate Projections 2018 (UKCP18). These are the latest climate projections for the U.K.

12.1.2. Climate resilience refers to the impact of climate on the NWL. As such, the study area is the NWL Boundary and the immediate surrounding area.

12.1.3. The ES assessment will undertake an assessment, identifying the climate variables (such as heat and weather) that the NWL is vulnerable to during construction and operation. It will identify any mitigation measures incorporated in the NWL design and construction plans and then determine the impacts on the NWL, identifying their significance and any additional mitigation measures required.

12.2 BASELINE

EXISTING BASELINE

Precipitation

12.2.1. The East of England is characterised as having low rainfall in comparison to the rest of the UK.

12.2.2. **Figure 12-1** shows the long-term average monthly rainfall for the East Anglia Region and Morley St Botolph Weather station[49] (approximately 18km south east of the NWL) between 1981 and 2010. It shows the region is drier than most parts of the UK throughout the year.

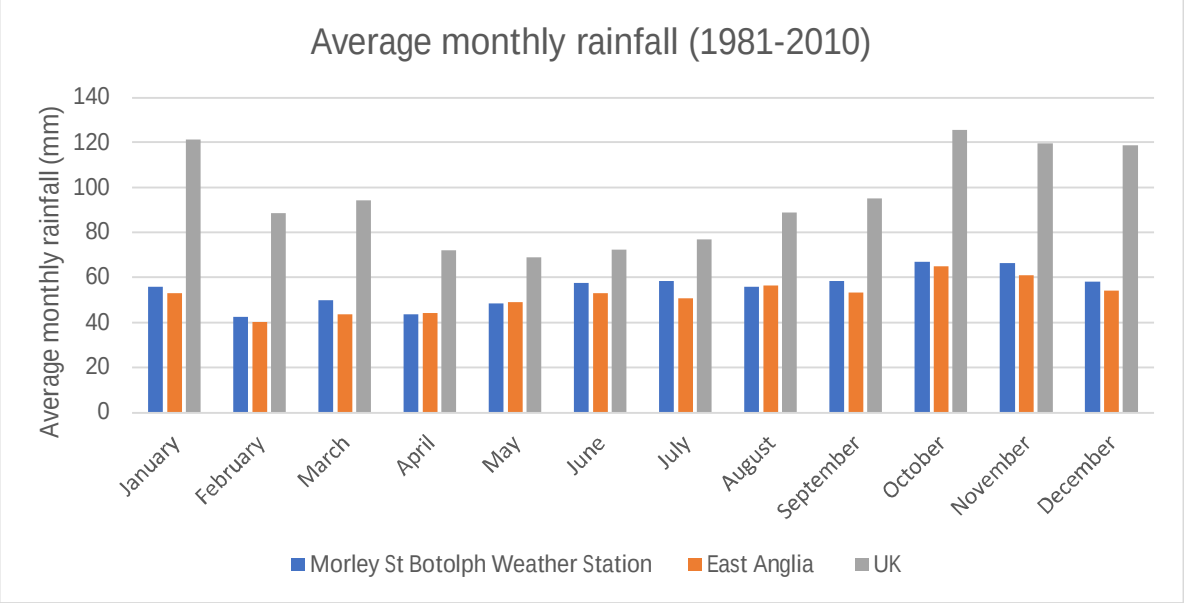

Figure 12-1 – Long Term Average Mean Monthly Rainfall for the East of England Region and Morley St Botolph Weather Station, in Comparison to the Rest of the UK

[48] Met Office (2018) East England: Climate https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/regional-climates/eastern-england_-climate---met-office.pdf . [Accessed 24/09/2020].

[49] Met Office UK Climate Averages https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/u12dzxjyc [Accessed 24/09/2020].

Extreme Precipitation Levels

12.2.3. While the region is drier than the UK average, it does experience extreme rainfall events. Some events include:

- 2010 to 2012 - Much of central, eastern and southern England and Wales experienced a prolonged period of below average rainfall; and
- June 2019: the UK experienced a spell of very wet weather mid-month.

Snow and Ice

12.2.4. For most of the east of England, snowfall is normally confined to November to April, but upland areas may have brief falls in October and May. Snow rarely lies outside the period from December to March. The region has recently experienced snow events in 2010, 2013 and 2018.

Temperature

12.2.5. **Figure 12-2** shows the long-term average mean monthly temperature for the East of England Region and Morley St Botolph Weather station[50] (approximately 18km miles south east of the NWL) between 1981 and 2010 is warmer than the UK average.

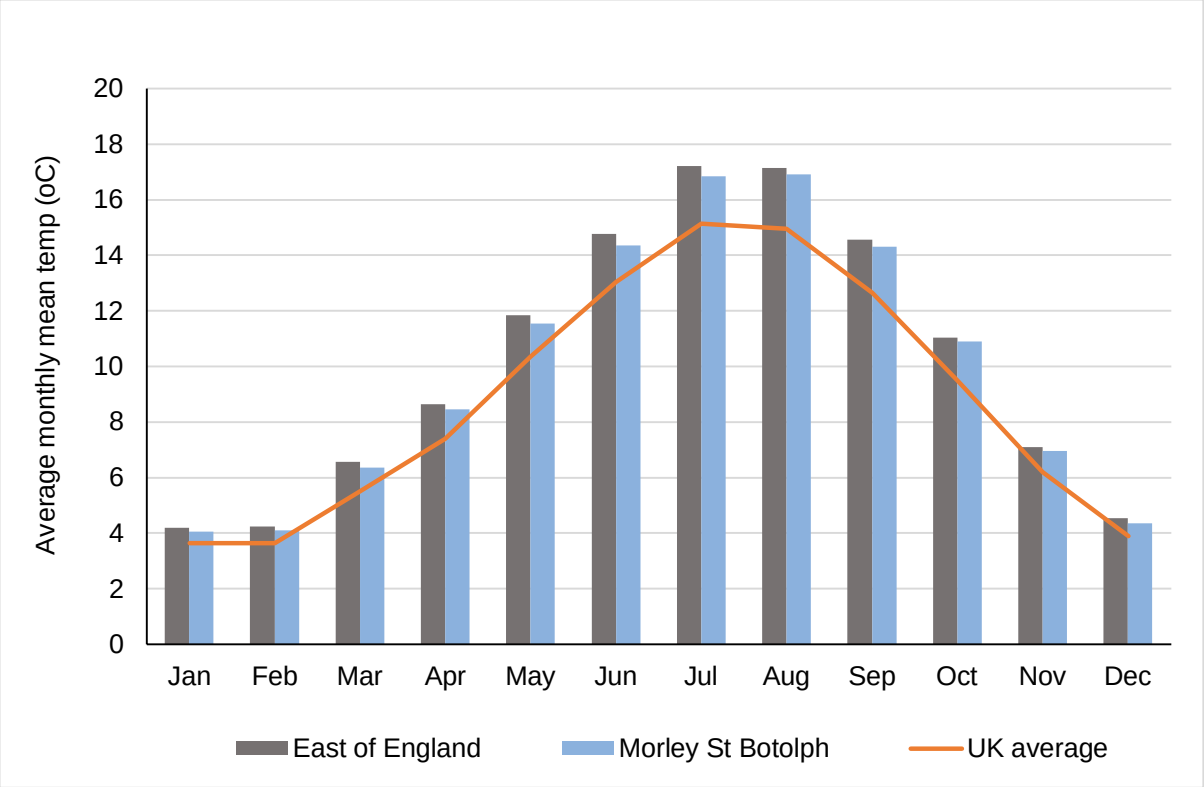

Figure 12-2 – Long-Term Average Mean Monthly Temperature for the East of England Region and Morley St Botolph Weather Station, in Comparison to the Rest of the UK

[50] Met Office UK Climate Averages https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/u12dzxjyc [Accessed 24/09/2020].

Extreme Temperature

12.2.6. The region experiences extreme temperatures. **Table 12-2** shows the average maximum and minimum summer (June, July and August) and winter (December, January and February) temperatures recorded.

Table 12-1 – Summer and Winter Mean Maximum and Temperatures in East England (1981-2010)

Period	Mean Maximum Temperature (°C)	Mean Minimum Temperature (°C)
Summer	21.3	11.4
Winter	7.3	1.4

Wind

12.2.7. Eastern England is one of the least windy parts of the UK. The strongest winds are associated with the passage of deep depressions across or close to the UK. The frequency of depressions is greatest during the winter months, when the strongest winds normally occur.

12.2.8. A day of gale is defined as a day when the wind speed attains a mean value of 34 knots or more over any period of ten minutes. Recent notable gales affecting the east of England occurred in October 2013 and in March 2019 (Storm Gareth).

FUTURE BASELINE

12.2.9. Climate projections are provided for different emission scenarios. For this assessment we have used the high emission scenario RCP8.5 ('business as usual') which combines assumptions about high population and relatively slow income growth with modest rates of technological change and energy intensity improvements, leading in the long-term to high energy demand and GHG emissions in the absence of climate change policies.

12.2.10. The future baseline has utilised projections for 2060s and 2080s to identify anticipated climate conditions over the life of the NWL.

Precipitation

12.2.11. Climate change is projected to lead to wetter winters and drier summers although natural variation will continue to punctuate these trends.

Extreme Precipitation

12.2.12. Climate change means that more rainfall will fall during 'intense' events, particularly in winter.

Temperature

12.2.13. Climate change is projected to lead to hotter summers and warmer winters.

Extreme Temperature

12.2.14. UKCP18 projects changes in maximum and minimum temperatures in both summer and winter in the 2060s and 2080s in the RCP 8.5 emissions scenario.

Snow and Ice

12.2.15. For future changes, rising winter temperatures are likely to reduce the amount snow in winter.

Wind

12.2.16. UKCP18 depicts widespread future changes in mean surface wind speed., However, due to uncertainty in projected changes is difficult to represent regional extreme winds and gusts within regional climate models.

12.2.17. Given the wide range of inter-model variation, robust projections of changes in storms are not possible

Solar Radiation

12.2.18. A recent (regional) study[51] suggests that the East of England is likely to see increased in annual solar radiation of 5.1watts per square metre (Wm-2) by the 2060s and 6.5Wm-2 (central estimate) by the 2080s under a high emissions scenario.

12.2.19. All regions of the UK are likely to have increased cloud cover (although there is uncertainty around future projections) and therefore slightly less solar radiation during the winter.

Relative Humidity

12.2.20. Climate change is projected to increase humidity within the UK. Summer and winter humidity in the study area is predicted to increase by 13% and 20% for the 2060s and 2080s respectively in summer and by 14% and 22% for the 2060s and 2080s respectively in winter (central estimates).

Sea Level Rise

12.2.21. The NWL is located approximately 26km from the sea and sea level rise is not considered relevant within this assessment.

[51] Burnett, D., Barbour, E. and Harrison, G.P. (2014) The UK solar energy resource and the impact of climate change. Renewable Energy, 71, 333-343.

12.3 POTENTIAL IMPACTS

12.3.1. In relation to resilience to climate change the NWL climate variables and key potential impacts considered for each of the sensitive receptors are outlined in **Table 12-2.** This is a non-exhaustive list of key potential impacts which will be explored further within the ES.

Table 12-2 – Climate Variables to be Considered within the ES and Their Key Potential Impacts

NWL Component (Construction and Operation)	Climate Variable		Key Potential Impacts
Road components	**Precipitation**	Changes in annual average	▪ Flooding of the carriageway;
		Extreme precipitation events	▪ Flooding of the carriageway;
		Drought	▪ Drying out and cracking of materials
	Temperature	Extreme temperature events	▪ Deformation and melting of paved surfaces;
	Wind	Gales and extreme wind events	▪ Damage from high winds and rain infiltration into surfaces and materials
	Water quality and soils	Soil moisture and Soil stability	▪ Waterlogging and erosion leading to destabilisation; ▪ Shrinking and cracking of soils; and ▪ Subsidence.
Structural components	**Precipitation**	Changes in annual average	▪ Damage to structures due to increased run-off;
		Extreme precipitation events	▪ Damage to structures due to increased run-off;
	Temperature	Extreme temperature events	▪ Increase in thermal expansion of joints within structures
	Wind	Gales and extreme wind events	▪ Increase in wind loading on structures
		Storms (hail, lightning)	▪ Destabilisation due to lighting strike
	Water quality and soils	Soil moisture and Soil stability	▪ Waterlogging and erosion leading to destabilisation; ▪ Shrinking and cracking of soils; and ▪ Subsidence.

Table continues on next page

NWL Component (Construction and Operation)	Climate Variable		Key Potential Impacts
Ancillary works	**Precipitation**	Extreme precipitation events	▪ Longer growing season, more vigorous vegetation growth in spring and autumn; ▪ Destruction of assets due to rain driven infiltration
	Temperature	Extreme temperature events	▪ Overheating of electronic equipment and fire risk; and ▪ Faster rate of deterioration of materials from increase in UV radiation e.g. fading, brittleness.
	Water quality and soils	Soil moisture and Soil stability	▪ Waterlogging and erosion leading to destabilisation; ▪ Shrinking and cracking of soils; and Subsidence.

12.4 POTENTIAL MITIGATION MEASURES AND ENHANCEMENT OPPORTUNITIES

12.4.1. Potential design, mitigation and enhancement measures, in line with current standards, that will be considered to reduce vulnerability to impacts of extreme weather events caused by climate change during construction and operation of the NWL include:

Design and Planning

- Ensure structures have been designed to take into account an increase in extreme wind and storm events as per the current standards requirements;
- Consider changes in precipitation and temperature when designing structures, earthworks and ancillary features such as drainage of surface water from road surfaces;
- Consider projections of extreme temperature when specifying materials and reconsidering the choice of materials when repair or replacement is necessary;
- Regular inspection of drainage infrastructure, materials and structures to identify any deterioration;
- A considered landscaping design would enhance drainage from root systems and increase biodiversity of native species and insects;
- More frequent vegetation management on verges for preventing fire hazards under extreme temperature/drought conditions; and
- Back-up power source for electrical equipment; and appropriate hazard and warning signage along the roadside.

Construction

12.4.2. An OCEMP will be prepared for the Planning Application and updated prior to construction by the appointed Contractor, to include method statements for the proposed works.

12.4.3. The OCEMP will consider the following potential measures for resilience to climatic factors:

- Ensuring construction compound drainage has capacity to cope with heavy rainfall events and that silt traps in use are regularly inspected and emptied;
- Sealing spoil heaps and stockpiles shortly after excavation and formation;
- Minimising the material stockpiled with regular inspections during and following extreme weather events;
- Provide adequate rest, shade and Personal Protective Equipment (PPE) for the workforce during periods of high temperature and high solar radiation;
- Consider adjusting the programme of activities or scheduling daily working time to account for weather conditions and implementing a protocol to adapt to weather events (e.g. routinely checking weather forecast and subscribing to EA flood warning alerts);
- Switching-off machinery when not in use;
- Ensuring access roads used during construction are monitored and taking local advice from the council or traffic authority regarding traffic management measures that may be required during times of extreme weather; and

13 POPULATION AND HUMAN HEALTH

13.1 BASELINE

13.1.1. A study area of the NWL Boundary has been identified to establish the baseline for private property and housing; development land and businesses; and agricultural land parcels. Additionally, a study area of 500m from the NWL Boundary has been applied to the assessment of community land and assets; walkers, cyclists and horse-riders (WCH); and human health.

13.1.2. Assessment of impacts on agricultural land holdings will utilise information available from previous consultation with landowners and users and involve further consultation should gaps be identified. The baseline and assessment of agricultural land parcels within the study area will be presented in the ES.

LAND-USE AND ACCESSIBILITY

Private Property and Housing

13.1.3. There are six private properties located within the NWL Boundary or with direct access located within the NWL Boundary. These comprise:

- One residential property located off the A1270 Broadland Northway with direct access within the NWL Boundary;
- One residential property on the A1067 Fakenham Road with direct access within the NWL Boundary;
- One residential property located off the A1067 Fakenham Road with direct access within the NWL Boundary; and
- Three residential properties located on Ringland Lane with direct accesses within the NWL Boundary.

13.1.4. There are no housing land allocations located within, directly adjacent to or proposed to be accessed from the NWL Boundary.

13.1.5. In addition Pump Farm and Woodstock residential dwellings have been acquired under a blight notice.

Community Land and Assets

13.1.6. Marl Hill Road Open Space and Honingham Recreation Ground are within the 500m study area, outside of the NWL Boundary.

13.1.7. There are no registered common land, village greens, allotments or playing fields located within the 500m study area.

13.1.8. Six recreational sites have been identified within the 500m study area, including: two golf clubs, one shooting ground, one paintball site, and one yoga studio.

13.1.9. Each identified open space and recreational site, has more than one access route with a good level of existing accessibility to community land. The exception is the yoga studio, having single access from Ringland Road to the recreational site and no PRoW links.

13.1.10. Community facilities are available to residents within settlements located wholly, or partly within 500m of the NWL Boundary including Weston Longville, Weston Green and Honingham. None of the identified community facilities are located within the site or the NWL.

Development Land and Businesses

13.1.11. Direct access to Khor Yoga lies within the NWL Boundary. There are no employment land allocations or existing businesses located within the NWL Boundary. Agricultural land holdings are considered separately below.

Agricultural Land Parcels

13.1.12. There are 27 fields located within the NWL Boundary with various agricultural purposes. Agricultural soils within the site are classified as Grade 2, 3 and 4[52]. There is the potential for Best and Most Versatile agricultural land (i.e. Grade 2 and 3a) presented within the site. Agricultural land parcel (farm) assessment is currently underway but baseline information is not available at the time of writing. Agricultural land parcel baseline information will be presented in the ES.

Walkers, Cyclists and Horse-Riders (WCH)

13.1.13. There are a total of three footpaths, three restricted byways and two cycleways located within the site, with an additional seven footpaths, one restricted byway, and three footways located within the 500m study area, as outlined in **Table 13-1**.

Table 13-1 – WCH Routes

Route Category	Road Name	Location
PRoW		
Footpath	Attlebridge FP5	Within the NWL Boundary
Restricted Byway	Attlebridge RB4	Within the NWL Boundary
Restricted Byway	Attlebridge RB6	Within the NWL Boundary
Footpath	Ringland FP1	Within the NWL Boundary
Footpath	Weston Longville FP9	Within the NWL Boundary
Restricted Byway	Honingham RB1	Within the NWL Boundary

Table continues on next page

[52] Natural England (2010), Agricultural Land Classification Map Eastern Region (ALC008). Available at: http://publications.naturalengland.org.uk/publication/127056?category=5954148537204736 [Last accessed: 15/06/2022]

Route Category	Road Name	Location
Restricted Byway	Attlebridge RB3	Within the Study Area
Footpath	Ringland FP2	Within the Study Area
Footpath	Ringland FP3	Within the Study Area
Footpath	Weston Longville FP2	Within the Study Area
Footpath	Weston Longville FP3	Within the Study Area
Footpath	East Tuddenham FP1	Within the Study Area
Footpath	East Tuddenham FP2	Within the Study Area
Footpath	Honingham FP3	Within the Study Area
Cycleways		
NCN1	Marriott's Way Circular	Within the NWL Boundary
	An unnamed cycleway at the roundabout between the A1270 Fakenham Road and the A1270 Broadland Northway	Within the NWL Boundary
Footways		
	Footway along westbound Dereham Road	Within the Study Area
	Footways along The Street	Within the Study Area
Non-designated routes use by WCH		
	Breck Road	Within the NWL Boundary
	Weston Road	Within the NWL Boundary
	Ringland lane	Within the NWL Boundary
	Blackbreck Lane	Within the Study Area

13.1.14. There are no national trails, or national or regional cycle networks within the NWL Boundary or the study area.

13.1.15. Bus services 608 and 23 operate along the A1067 which connect with the northern extent of the NWL on A1067 Fakenham Road. There are no bus stops, taxi ranks, or railway stations located within the NWL Boundary.

13.1.16. At the southern extent of the NWL, buses 4 and 8 plus the A, B and C Excel services operate along the A47 corridor from Dereham to Norwich. There are no existing bus stops within 500m of the NWL. The scheme is unlikely to significantly affect bus services in the immediate vicinity of the site. However a Sustainable Transport Strategy is proposed which includes identification of new bus routes which could serve the western urban fringe of Norwich to improve direct connectivity for residents in the west of Norwich to University of East Anglia, Norwich Research Park and the Norfolk and Norwich University Hospital. There is also a review of existing bus stops being carried out to identify potential opportunities for enhancing the quality of the passenger waiting environment.

HUMAN HEALTH

13.1.17. The NWL lies within the ward of Great Witchingham and Mattishall, and the county of Norfolk. The general health statistics for the county are:

- The population of Norfolk is comparatively older than the regional and national averages, with a larger proportion of the population aged between 55 and above 90; and
- Life expectancy[53] at birth for both males and females in Norfolk is largely in line with the regional and national averages.

13.1.18. Overall, in comparison to the UK average, the population within the study area is generally older with a higher percentage of respiratory illness and would therefore have limited resilience to potential changes to health outcomes.

13.2 POTENTIAL IMPACTS

PRIVATE PROPERTY AND HOUSING

13.2.1. There is potential for adverse impacts from land take (for example, permanent loss of garden space or other land associated with private property) on private residential properties, which are located on farmland (impacts on farm businesses are described separately below). Potential temporary adverse impacts on residential properties are also anticipated due to temporary land take during construction.

13.2.2. There are no secured housing allocations located within or adjacent to the site, so there would be no impact on land for housing development.

13.2.3. No further impacts on private property and housing are anticipated during operation.

COMMUNITY LAND AND ASSETS

13.2.4. No direct impacts on community land and assets are anticipated during construction.

13.2.5. There is potential for temporary adverse impacts on community land and assets during construction where access routes are temporarily closed or diverted. The implementation of signed PRoW, non-designated route diversions, and other measures would potentially reduce the level of impact.

13.2.6. There is potential for permanent beneficial impacts on community land and assets during operation, where the NWL will provide a new access route between the north and south of outer Norwich.

[53] Public Health England (2018), Local Authority Health Profiles - Norfolk. Available at: https://fingertips.phe.org.uk/profile/health-profiles/data#page/1/gid/1938132701/pat/6/par/E12000006/ati/202/are/E10000020/iid/90366/age/1/sex/1/cid/4 [Last accessed: 01/10/2020]

13.2.7. There is potential for permanent adverse and beneficial impacts in accessing community land and assets, where the proposed permanent stopping up of local roads (e.g. The Broadway, Breck Road and Church Hill Lane/Weston Road) is likely to cause severance for local vehicle users. Whilst the proposed new PRoWs are likely to improve access to community land and assets for local non-motorised users. Some of the PRoWs would follow the route of the proposed Weston greenbridge and Broadway greenbridge.

DEVELOPMENT LAND AND BUSINESSES

13.2.8. There is potential for a temporary adverse impact on one business during construction from access disruption during construction. The implementation of measures to maintain access to the business would potentially reduce the level of impact.

13.2.9. No impacts are anticipated on businesses during operation.

AGRICULTURAL LAND HOLDINGS

13.2.10. There is potential for temporary and permanent adverse impacts on agricultural land parcels (farms) during construction which could affect the viability of the agricultural land holdings. Should there be habitat loss due to land take from agricultural land holdings, there is potential for permanent adverse impacts for farm owners benefiting from environmental stewardship schemes on this land.

WALKERS, CYCLISTS AND HORSE-RIDERS (WCH)

13.2.11. There is potential for temporary adverse journey length and user experience impacts on WCH, where temporary closures and diversions are required during construction. These include two restricted byways, and two public footpaths.

13.2.12. The proposed Sustainable Transport Strategy (STS) includes the provision of new rights of way, and diversions of existing rights of way, parallel with sections of the NWL and the surrounding area of the NWL. New public bridleways are proposed over Morton Green Bridge and The Broadway Green Bridge to connect local communities on either side of the NWL. This will offer priority to Non-Motorised Users over the private car and enhanced access to the Public Right of Way network, with the scheme offering improved connectivity of an existing fragmented PROW network.

13.2.13. At the north end of the NWL route, new footpaths will be designated over proposed maintenance tracks, enhancing access to the Wensum Valley and connecting with Ringland FP1 which currently crosses the River Wensum.

13.2.14. At the southern boundary of the NWL site, Honingham Restricted Byway RB1 will be diverted along the eastern boundary of the NWL, making a purpose built new route which is accessible to all Non-Motorised Users. This will connect with a proposed grade separated NMU crossing which forms part of the A47 North Tuddenham to Easton dualling scheme, being delivered by National Highways. This is a substantial improvement which will alleviate an existing severance issue, where Honingham RB1 crosses the existing A47 at grade which is intimidating for users and therefore not currently used. The existing RB1 route is also not easily accessible where it meets Wood Lane and the existing route has no surfacing, so is a comparatively poor quality route that is rarely used. Whilst the NWL scheme will divert this route, with a slightly longer alignment, the new RB1 will have improved surfacing and will offer continuous connectivity with grade separated crossings and onward links to other routes enabling circular walks and improving connections between Honingham

and Weston Green for all NMUs. This is considered to be an overall benefit in the context of Human Health.

13.2.15. In the wider area, outside of the scheme extents, a series of cycle and bus measures are proposed to create a safer and more accessible walking and cycling network that links NMU routes surrounding the NWL to local communities and the wider rights of way network. The cycle friendly routes are intended to link communities with key land uses such as schools, shops and jobs in the local area. The NWL main carriageway will assist with making the routes more attractive by alleviating rural lanes from rat running traffic and additional measures will be implemented to help reduce vehicle speeds and improve cycling level of service where appropriate. There is potential for permanent increase in journey length for a very small number of existing WCH users. However, the quality of the new routes will be significantly enhanced, offering an improved user experience, which is likely to attract and increase in usage in comparison with the existing routes. With enhanced connectivity of the routes to form an overall network, joining up existing sections of isolated PROWs, this will contribute to a more enjoyable user experience of the local PROW network and improve access to the countryside. There is an overall increase in the length of PROW routes available to the local communities which enhances opportunities for recreational activity and with a reduction/removal of motor vehicle users, active travel will become more attractive. The proposed provision of green bridges as part of the supporting works addresses severance issues where the NWL crosses existing public highways. The green bridges would be accessible to Non-Motorised Users only so would offer fully segregated NMU infrastructure, with clear priority over vehicles. This is expected to create a substantial benefit to local communities who will be able to more readily access and enjoy the countryside.

13.2.16. The proposed shared footway and cycleway along the north side of A1067 Fakenham Road will link two existing restricted byways with the existing Broadland Northway Cycleway (Taverham BR3) and is likely to potentially provide permanent beneficial impacts and improve WCH safety and connectivity for users accessing PRoW north of the A1067 Fakenham Road.

13.2.17. Access to two sections of Breck Road and Weston Road, where the NWL crosses the existing highways, would be restricted to WCH only providing potential permanent beneficial impacts and is likely to improve WCH safety in accessing the identified road sections.

HUMAN HEALTH

13.2.18. The NWL has the potential for positive and negative human health outcomes in relation to air quality, noise, visual, PRoW and water environment. These will be assessed in detail in the corresponding ES chapters. Potential human health outcome identified from **Chapter 2: Air Quality**, **Chapter 5: Landscape and Visual**, **Chapter 3: Noise and Vibration**, and **Chapter 8: Road Drainage and the Water Environment** have been summarised in this section.

13.2.19. There is potential for temporary negative human health outcomes during construction due to potential increases in air and noise pollution. However, control measures to be developed in the OCEMP document could reduce the negative outcome.

13.2.20. There is potential for permanent adverse effects on visual amenity and flood risk, which may have a negative human health outcome but measures listed in **Section 5.3** and **Section 8.3** of this document could mitigate the potential negative outcome.

13.2.21. The proposed shared footway and cycleway along the A1067 Fakenham Road will link two existing restricted byways and reduce the likelihood of walkers and cyclists going onto the A1067 Fakenham Road. This is likely to have a positive human health outcomes and has the potential to improve WCH safety in accessing PRoW north of the A1067 Fakenham Road encouraging people to take up healthy pursuits and physical activity.

13.2.22. The proposed active travel measures proposed in STS provide potential for positive human health outcomes with the potential to improve WCH safety by providing dedicated routes for WCH only between the A47 and A1067 Fakenham Road and encouraging physical activity.

13.2.23. Potential temporary and permanent PROW diversions, which provide potential for negative human health outcomes by increasing journey time and discouraging WCH journeys, reducing levels of physical activity. The proposed provision of two green bridges at The Broadway and Weston Green have the potential to lessen these health impacts. Although the proposed PRoW would be located in close proximity to a new road, it is noted that there would be improved surfacing and provision of signage along the proposed PROW. These have the potential for beneficial human health outcome by improving journey quality. The new bridges will also be landscaped so that they are able to function as green bridges for ecological purposes. The vegetation will increase the attractiveness of the routes for users and will offer an attractive and enjoyable environment for walking, cycling and horse riding.

13.2.24. Potential for positive and negative human health outcomes during operation due to diverting and introducing new roadside air quality and noise emissions from vehicles to human receptors will be assessed in detail in the correspondent corresponding ES chapters. It is noted that traffic mitigation is proposed on routes anticipated to be affected by noticeable increase in traffic flow north of the A1067 Fakenham Road and south of the A47. The mitigation proposals are intended to counteract the increases in traffic through the villages of Attlebrigde, Felthorpe and Stratton Strawless north of A1067; and communities between Honingham and Wymondham south of A47. The measures include vehicle speed limit reductions, weight restrictions to reduce the HGV component of traffic and access restrictions to deter longer distance through-traffic.

13.3 POTENTIAL MITIGATION MEASURES AND ENHANCEMENT OPPORTUNITIES

13.3.1. This section should be read in conjunction with **Chapter 2: Air Quality**, **Chapter 5: Landscape and Visual**, **Chapter 3: Noise and Vibration**, and **Chapter 8: Road Drainage and the Water Environment** of this document.

CONSTRUCTION

13.3.2. Mitigation measures will be confirmed through the ES assessment. Likely mitigation measures are as follows:

- Where possible, acquisition of land would be managed through negotiations with stakeholders to mitigate impact and landowners will be compensated where necessary;
- Where practicable, access to residential and commercial properties will remain open, with alternatives provided and managed where necessary;
- Where possible, land that is no longer required for the NWL will be returned to its former use;

- Through the on-going ES and design development process, the NWL will seek to minimise landtake from farm land where practicable.
- Appropriate drainage systems will be included along the NWL alignment, with monitoring in place during operation, to attenuate road run-off and prevent potential flood issues arising;
- Should PRoW be obstructed, appropriate diversions will be implemented where practicable during construction to minimise effects for WCH travelling between community land and assets. Where appropriate diversions are not available, temporary closures may be required;
- Any PRoW, footway or carriageway diversions or closures undertaken during construction will be clearly advertised prior to commencement of works. Clear signage will be provided;
- Design of the diverted routes for WCH will take into account vulnerable user groups where practicable;
- A CEMP and construction traffic management measures will be implemented;
- Contractors will liaise with residents and user groups, prior to works to ensure contractors act considerately in relation to local residents and businesses; and
- Human Health related mitigation measures are presented in **Chapter 2: Air Quality**, **Chapter 5: Landscape and Visual**, **Chapter 3: Noise and Vibration**, and **Chapter 8: Road Drainage and the Water Environment** of this document.

OPERATION

13.3.3. Likely mitigation measures to be implemented during the operation phase are as follows:

- Alternative access provided to affected agricultural land parcels during operation; and
- Human Health related mitigation measures are presented in **Chapter 2: Air Quality**, **Chapter 5: Landscape and Visual**, **Chapter 3: Noise and Vibration**, and **Chapter 8: Road Drainage and the Water Environment** of this document.

14 MAJOR ACCIDENTS AND DISASTERS

14.1 BASELINE

14.1.1. The extent of the study area is a 2.5km radius around the NWL Boundary. Within the study area, accident and disaster groups and categories have been considered both within and outside the NWL Boundary, along with potential external influencing factors including natural and man-made hazards.

14.1.2. The baseline relevant to this topic comprises:

- Features external to the NWL that contribute a potential source of hazard to the NWL;
- Sensitive environmental receptors at risk of significant effects; and
- Current (without the NWL) major accident and disaster risks in the locality.

14.1.3. Areas of the NWL Boundary are within the Consultation Distance (CD) for a Major Accident Hazard pipeline operated by National Grid.

14.1.4. There is a potential for natural cavities, such as sinkholes and solution pipes, given the nature of the local geology underlying the NWL.

14.1.5. Elements of the NWL are located in Flood Zone 3, which is classified as an area with a high probability of flooding (greater than a 1 in 100 (1%) risk of fluvial flooding in any year). The high flood risk stems from the presence of the River Wensum which runs across the northern end of the NWL.

14.2 POTENTIAL IMPACTS

14.2.1. **Table 14-1** provides a summary of major accident types to be assessed to identify the potential vulnerability of the NWL to a major accident/disaster as part of the ES.

Table 14-1 – MA&D Elements to be Considered within the ES

MA&D Group - Categories	Justification
Natural Hazards - Geophysical	Chalk mining, sinkholes and dissolution features present a general risk for the NWL. The design shall consider the associated risks and incorporate appropriate mitigation measures.
Technological or manmade hazards - Industrial/Urban Accidents	Parts of the site overlap with a Major Accident Hazard (MAH) pipeline which makes the NWL potentially vulnerable to the risk of a major fire/explosion. Increased societal risk due to the presence of road users and road maintenance personnel during operation that did not previously exist within the MAH Consultation Zone. These risks require further consideration in the ES.

14.3 POTENTIAL MITIGATION MEASURES

Specific mitigation measures will be identified in the relevant topic chapters of the ES. In addition, the following measures will be considered:

- The design of the road network will be subject to relevant Hazard Identification (HAZID)/road safety studies and actions identified integrated into the final design);
- The construction stage(s) of the NWL will be managed through the implementation of the Construction Phase Plan (required under the CDM Regulations 2015) and CEMP; and
- The NWL is being designed and its implementation guided by other industry standards and codes, many of which are mandatory.

15 REFERENCES

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Reference	Source
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Appendix A

ENVIRONMENTAL CONSTRAINTS FIGURES – MAPS ENCLOSED

Drawn By: UKAEC002

File: \\uk.wspgroup.com\central data\Projects\70041922 - Norwich Western Link\02 WIP\EI EIA\03 Document\Environmental Information Document\GIS\20220511_Constraints_Plan_Non_Ecology.mxd

Attlebridge
Weston Longville
Weston Green
Weston Green Rd
Weston Rd
The Broadway
Ringland
Honingham
A1067
A1270
A47
Attlebridge RB4
Attlebridge FP5
Ringland FP1
Ringland FP4
Ringland FP3
Ringland FP2
Ringland Ln
Weston Longville FP9
Ringland FP7
Honingham RB1

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0 0.125 0.25 0.5 0.75 1 Kilometres

DO NOT SCALE

Key

- Norwich Western Link
- National Highways A47 North Tuddenham to Easton Improvement
- Site Extents Boundary

Heritage

- Listed Buildings
- Heritage Conservation Areas

Public Rights of Way

- Public Right of Way

Rivers

- Main Rivers
- Ordinary Watercourses

Air Quality and Noise

- Noise Important Areas

Flood Zones

- Flood Zone 3
- Flood Zone 2

Source Protection Zones, ecological designated sites and ecological constraints are presented on separate plans

PROJECT:	NORWICH WESTERN LINK
TITLE:	EID FIGURE 1: GENERAL ENVIRONMENTAL CONSTRAINTS

SCALE @ A1:	CHECKED:	APPROVED:
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PROJECT No:	DRAWING No:	REV:
70041922	70041922-EID-001	P06

Drawn By: UKAEC002

DO NOT SCALE

Key

- Norwich Western Link
- National Highways A47 North Tuddenham to Easton Improvement
- Site Extents Boundary

Groundwater Source Protection

- Zone I - Inner Protection Zone
- Zone II - Outer Protection Zone
- Zone III - Total Catchment

Weston Longville
A1067
A1270
A1067
Weston Green Rd
Ringland Ln
Weston Green
Weston Rd
The Broadway
Ringland
A47
Honingham

0 0.125 0.25 0.5 0.75 1 Kilometres

PROJECT:	NORWICH WESTERN LINK
TITLE:	EID FIGURE 2: SOURCE PROTECTION ZONES
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CAD FILE: N/A	DESIGN-DRAWN: UKAEC002 / DATE: 11/05/2022
PROJECT No: 70041922	DRAWING No: 70041922-EID-002 / REV: P05

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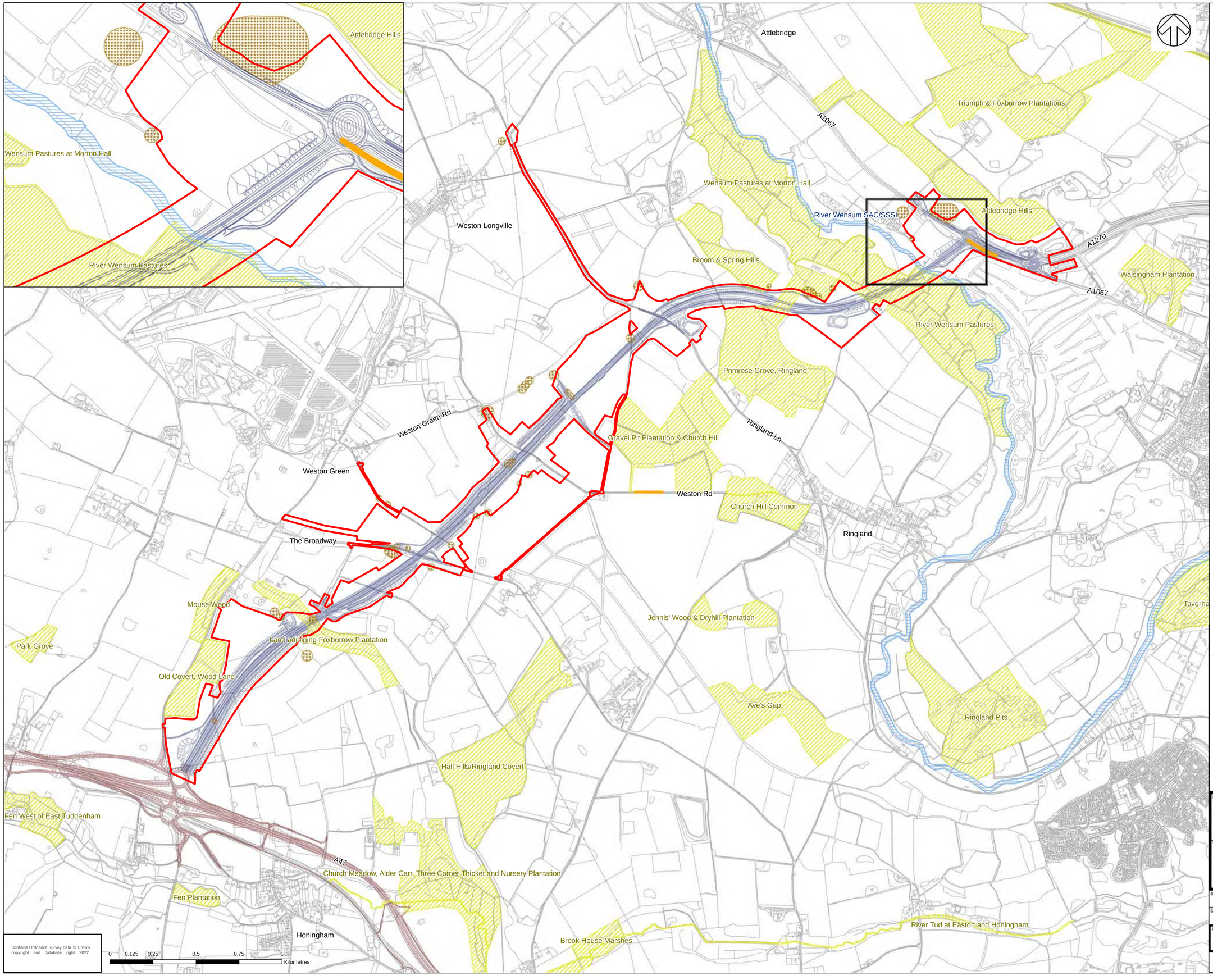

DO NOT SCALE

Key

- Norwich Western Link
- National Highways A47 North Tuddenham to Easton Improvement
- Site Extents Boundary

Protected Areas

- Special Area of Conservation / Site of Special Scientific Interest
- Surveyed Ancient / Veteran Tree Root Protection Area intersecting the Site Extent
- County Wildlife Site
- Roadside Nature Reserve

PROJECT:	NORWICH WESTERN LINK
TITLE:	EID FIGURE 3: ECOLOGY DESIGNATED SITES AND CONSTRAINTS

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DO NOT SCALE

Key

- Site Extents Boundary
- Special Area of Conservation
- Site of Special Scientific Interest

Paston Great Barn

Norfolk Valley Fens

Norfolk Valley Fens

Alderford Common

Swannington Upgate Common

River Wensum SAC/SSSI

Hockering Wood

Norfolk Valley Fens

Norfolk Valley Fens

NORTH WALSHAM

AYLSHAM

REEPHAM

DEREHAM

NORWICH

0 0.75 1.5 3 4.5 6 Kilometres

PROJECT: NORWICH WESTERN LINK

TITLE: EID FIGURE 4: INTERNATIONAL AND NATIONAL DESIGNATED SITES WITHIN DEFINED STUDY AREAS FROM THE NWL

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PROJECT No:	DRAWING No:	REV:
70041922	70041922-EID-004	P02

The information regarding protected species is based on the survey information to date. Please note that not all surveys are complete and therefore this map will develop further as the Scheme progresses.

Similar to the southern section, the northern woodlands, including Ringland Lane, have been identified as areas of high sensitivity for both commuting and foraging bats, specifically Barbastelle

FLOODPLAIN - this area comprises wet grassland and smaller streams / ditches associated with the River Wensum SAC

Woodland associated with The Broadway, The Foxburrow Plantation and the connecting farm track, have been identified as areas of high sensitivity for both commuting and foraging bats, specifically Barbastelle.

Attlebridge
A1067
River Wensum SAC/SSSI
A1270
Weston Longville
Weston Green Rd
Weston Green
Weston Rd
Ringland Ln
Ringland
The Broadway
A47

N

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED AND ONLY WRITTEN DIMENSIONS SHALL BE USED

Legend

- Scheme Boundary
- Route alignment
- Grassland
- Woodland
- Running water
- Pond
- Ancient Woodland
- Confirmed bat roost
- Desmoulin's Whorl Snail present
- Great Crested Newt pond
- Great Crested Newt pond 500 metre buffer
- Otter spraint, feeding signs and prints
- Otter sighting in 2019, 2020 and 2021
- Water vole evidence present
- Important surveyed hedgerows intersecting the Scheme boundary
- Surveyed hedgerows intersecting the Scheme boundary
- Japanese knotweed

Badger and barn owl records cannot be shown due to their exact locations being confidential

	By / Check	Date	Suffix
Update Scheme boundary and alignment	RE / SM	07/06/22	004
Update template	RE / SM	20/10/21	003
Update Scheme boundary	RE / SM	13/10/21	002
Bat roosts added	RE / SM	14/09/21	001
Revision Details	By / Check	Date	Suffix

Drawing Status: FINAL

Job Title: Norfolk County Council
Norwich Western Link

Drawing Title: EID Figure 5: Ecological Constraints, Habitats and Protected Species
Page 1 of 5

Scale at A1	1:10,000		
Drawn	UKRXE005		
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SM	IE	RE	01/07/2022

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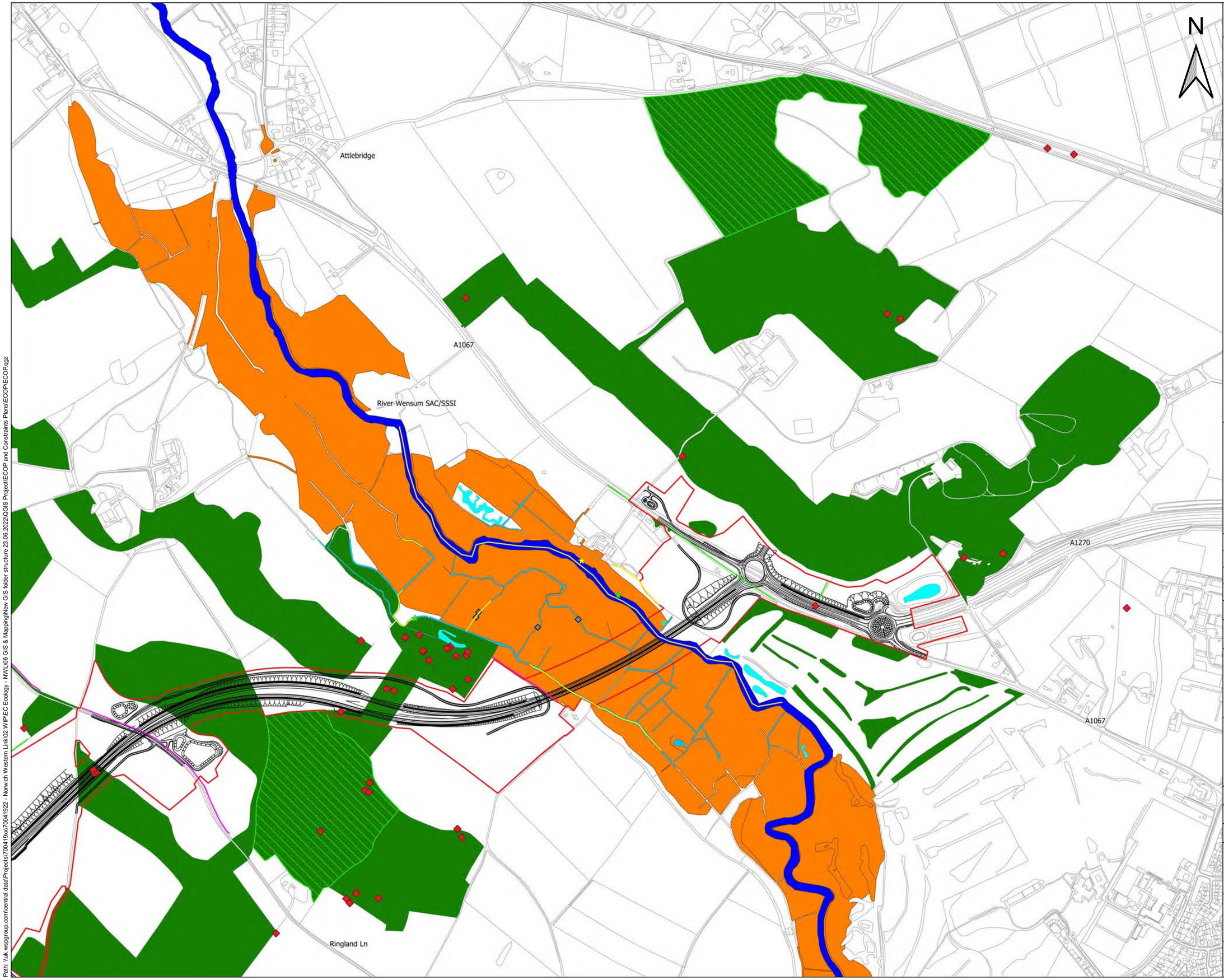

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED AND ONLY WRITTEN DIMENSIONS SHALL BE USED

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Legend

- Scheme Boundary
- Route alignment
- Grassland
- Woodland
- Running water
- Pond
- Ancient Woodland
- Confirmed bat roost
- Desmoulin's Whorl Snail present
- Great Crested Newt pond
- Great Crested Newt pond 500 metre buffer
- Otter spraint, feeding signs and prints
- Otter sighting in 2019, 2020 and 2021
- Water vole evidence present
- Important surveyed hedgerows intersecting the Scheme boundary
- Surveyed hedgerows intersecting the Scheme boundary
- Japanese knotweed

Badger and barn owl records cannot be shown due to their exact locations being confidential

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Update template	RE / SM	20/10/21	003
Update Scheme boundary	RE / SM	13/10/21	002
Bat roosts added	RE / SM	14/09/21	001
Revision Details	By / Check	Date	Suffix

Drawing Status: FINAL

Job Title: Norfolk County Council Norwich Western Link

Drawing Title: EID Figure 5: Ecological Constraints, Habitats and Protected Species Page 2 of 5

Scale at A1: 1:5,000

Drawn: UKRXE005

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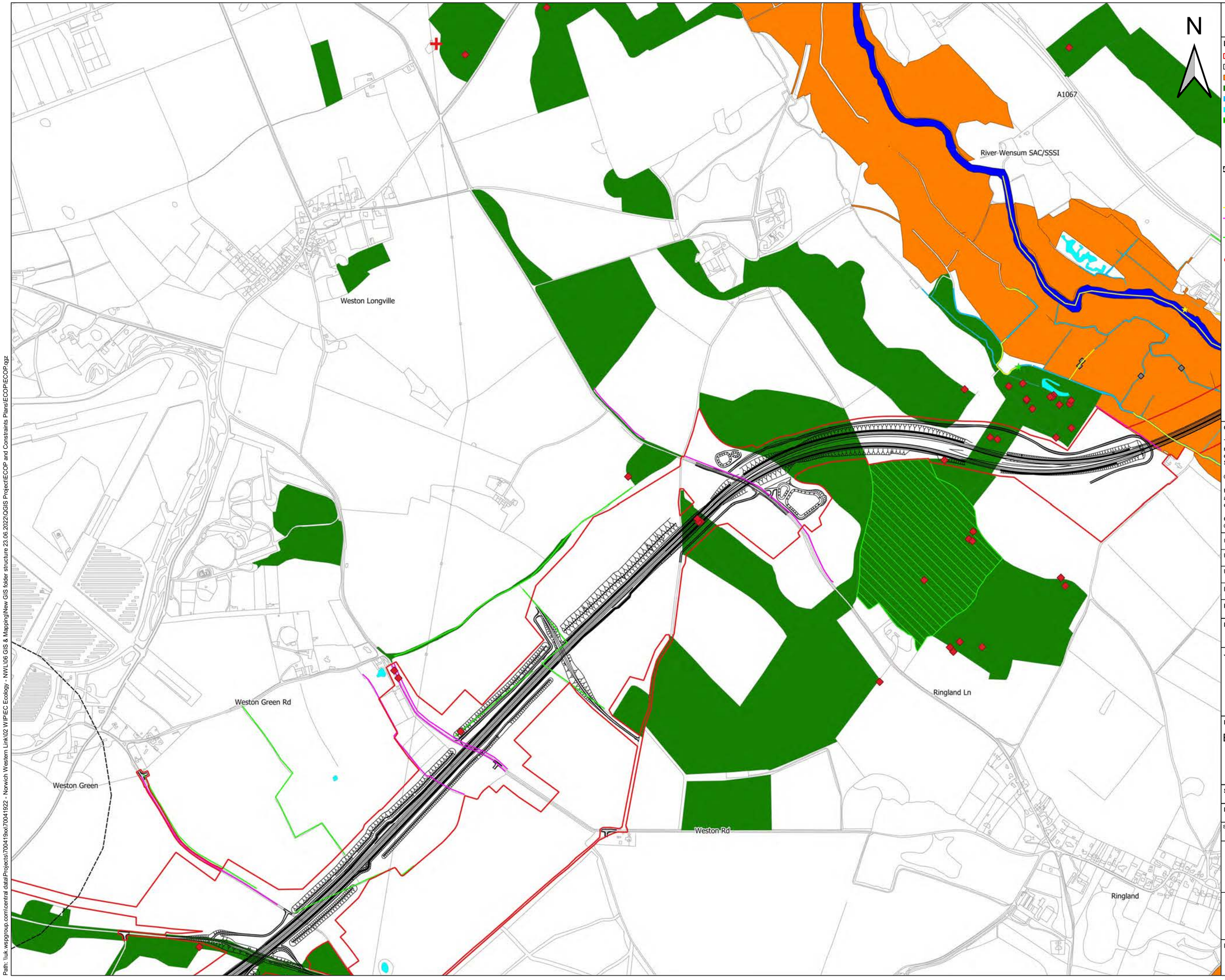

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED AND ONLY WRITTEN DIMENSIONS SHALL BE USED

Legend

- Scheme Boundary
- Route alignment
- Grassland
- Woodland
- Running water
- Pond
- Ancient Woodland
- Confirmed bat roost
- Desmoulin's Whorl Snail present
- Great Crested Newt pond
- Great Crested Newt pond 500 metre buffer
- Otter spraint, feeding signs and prints
- Otter sighting in 2019, 2020 and 2021
- Water vole evidence present
- Important surveyed hedgerows intersecting the Scheme boundary
- Surveyed hedgerows intersecting the Scheme boundary
- Japanese knotweed

Badger and barn owl records cannot be shown due to their exact locations being confidential

Revision Details	By / Check	Date	Suffix
Update Scheme boundary and alignment	RE / SM	07/06/22	004
Update template	RE / SM	20/10/21	003
Update Scheme boundary	RE / SM	13/10/21	002
Bat roosts added	RE / SM	14/09/21	001

Drawing Status: FINAL

Job Title: Norfolk County Council
Norwich Western Link

Drawing Title: EID Figure 5: Ecological Constraints, Habitats and Protected Species
Page 3 of 5

Scale at A1: 1:5,000

Drawn			
UKRXE005			
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THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED AND ONLY WRITTEN DIMENSIONS SHALL BE USED

Legend

- Scheme Boundary
- Route alignment
- Grassland
- Woodland
- Running water
- Pond
- Ancient Woodland
- Confirmed bat roost
- Desmoulin's Whorl Snail present
- Great Crested Newt pond
- Great Crested Newt pond 500 metre buffer
- Otter spraint, feeding signs and prints
- Otter sighting in 2019, 2020 and 2021
- Water vole evidence present
- Important surveyed hedgerows intersecting the Scheme boundary
- Surveyed hedgerows intersecting the Scheme boundary
- Japanese knotweed

Badger and barn owl records cannot be shown due to their exact locations being confidential

Revision Details	By / Check	Date	Suffix
Update Scheme boundary and alignment	RE / SM	07/06/22	004
Update template	RE / SM	20/10/21	003
Update Scheme boundary	RE / SM	13/10/21	002
Bat roosts added	RE / SM	14/09/21	001

Drawing Status
FINAL

Job Title
Norfolk County Council
Norwich Western Link

Drawing Title
EID Figure 5: Ecological Constraints, Habitats and Protected Species
Page 4 of 5

Scale at A1: 1:5,000

Drawn: UKRXE005

Stage 1 Check	Stage 2 Check	Originated	Date
SM	IE	RE	01/07/2022

0 70 140 210 280 350 m

wsp

Drawing Number
NCCT41793-03-C-18-3000-0109

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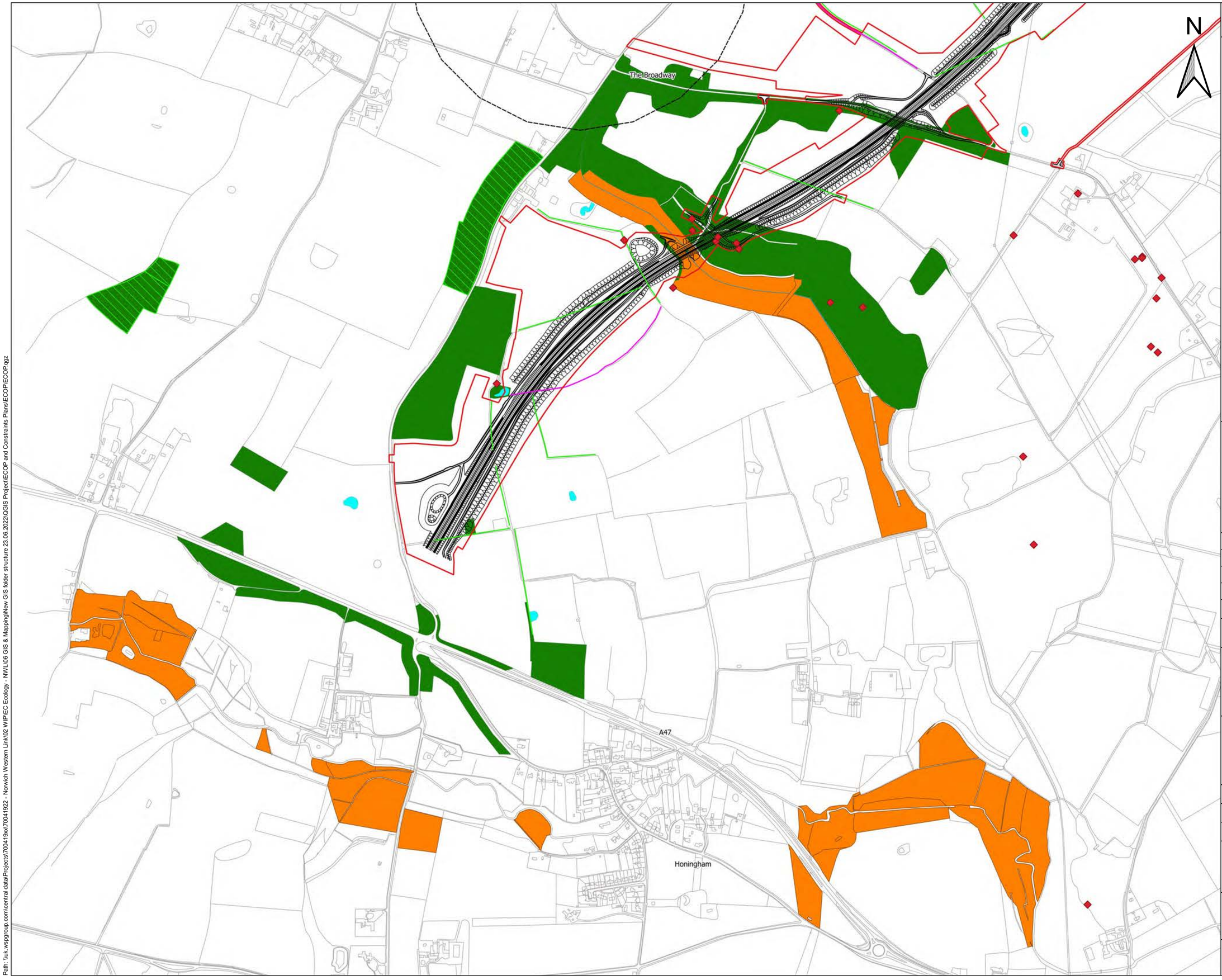

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED AND ONLY WRITTEN DIMENSIONS SHALL BE USED

Legend

- Scheme Boundary
- Route alignment
- Grassland
- Woodland
- Running water
- Pond
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Bat roosts added	RE / SM	14/09/21	001

Drawing Status: FINAL

Job Title: Norfolk County Council
Norwich Western Link

Drawing Title: EID Figure 5: Ecological Constraints, Habitats and Protected Species
Page 5 of 5

Scale at A1: 1:5,000

Drawn			
UKRXE005			
Stage 1 Check	Stage 2 Check	Originated	Date
SM	IE	RE	01/07/2022

0 70 140 210 280 350 m

Drawing Number: NCCT41793-03-C-18-3000-0110

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