

# A47 NORTH TUDDENHAM TO EASTON

## Preliminary Environmental Information Report

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# 1. Introduction

## 1.1. The A47 North Tuddenham to Easton

- 1.1.1. It is proposed to upgrade the existing section of single carriageway between North Tuddenham and Easton to a dual carriageway. The scheme runs south of Hockering before moving parallel to the existing A47 and north east of Honingham. This scheme will henceforth be referred to as the 'Proposed Scheme'.
- 1.1.2. The North Tuddenham to Easton section of the A47 is located approximately 10km to the west of Norwich. This approximately 8km long single carriageway section of the A47 forms a part of the main arterial highway route connecting Norwich to the west of Norwich.
- 1.1.3. This section of road is an important highway link for both local commuter traffic to and from the west of Norwich as well as providing the main route in the area for longer distance trips across the country travelling east and west.

## 1.2. The purpose of this report

- 1.2.1. The purpose of this Preliminary Environmental Information Report (PEIR) is firstly to meet the requirements of the Infrastructure Planning (Environmental Impact Assessment) EIA Regulations 2017, but also to inform the public, landowners, prescribed bodies and other stakeholders about the ongoing Environmental Impact Assessment (EIA) work and the preliminary information on the environmental impacts of the development proposals.
- 1.2.2. Preliminary Environmental Information is defined by the Infrastructure Planning EIA Regulations 2017, Regulation 12(2) with advice updates to some chapters (Biodiversity, Climate, Materials, People and communities – Social and Geology & soils) in Advice Note Seven (EIA: Process, Preliminary Environmental Information and Environmental Statements –The Planning Inspectorate, December 2017). This is defined as 'information' referred to in regulation 14(2) which:
  - *(a) has been compiled by the applicant*
  - *(b) is reasonably required for the consultation bodies to develop an informed view of the likely significant environmental effects of the development (and of any associated development)*
- 1.2.3. This PEIR therefore provides a preliminary assessment of the potential environmental impacts and known receptors within each of the environmental topic study areas. This document gives stakeholders an understanding of the

potential environmental impacts of the Proposed Scheme and of the measures proposed to reduce those impacts at this early stage of the EIA. Environmental surveys to inform the Environmental Statement (ES) are still ongoing and further information on these will be provided within the ES.

### **1.3. Availability of the PEIR**

- 1.3.1. Copies of the PEIR will be available as part of the consultation material produced for the A47 North Tuddenham to Easton statutory public consultation to be carried out in February and March 2020. Details of the consultation events are available in the Statement of Community Consultation (SoCC), a copy of which can be accessed via the following link:

<https://highwaysengland.co.uk/projects/a47-north-tuddenham-to-easton-improvement-scheme/>

## 2. The proposed scheme

### 2.1. Overview

- 2.1.1. The A47 is part of the Strategic Road Network (SRN). The A47 from North Tuddenham to Easton is located to the west of Norwich and forms part of the main arterial highway route connecting the cities of Norwich (population over 210,000) and Peterborough (population over 180,000), the towns of Wisbech, Kings Lynn, Dereham, Great Yarmouth and Lowestoft. The A47 North Tuddenham to Easton dualling scheme forms part of the Roads Investment Strategy (RIS) commitments, setting out Highways England's plans for motorways and major roads.

### 2.2. Need for the scheme

- 2.2.1. The section of single carriageway section of the A47 from North Tuddenham to Easton is approximately 8km, acts as a bottleneck resulting in congestion and leading to longer and unreliable journey times.
- 2.2.2. There are several reasons for these delays. Investigations to date have highlighted the following issues:
- development in the local area, which can lead to potentially more vehicles on the road
  - road layout
  - difficulty of accessing and crossing the A47
  - standard of the road and junctions
  - traffic levels outgrowing the capacity of the road, causing tailbacks and delays
  - limited opportunities for overtaking slower moving vehicles
- 2.2.3. If nothing is done to improve capacity and connectivity, these delays are forecast to get worse in future years. In developing the Proposed Scheme, Highways England aim to address these issues by constructing a high-quality dual carriageway link which is intended to improve the traffic flow, reduce journey times on the route and increase the route safety and resilience. The Proposed Scheme is also intended to support economic growth by making journeys safer and more reliable.

### 2.3. Location

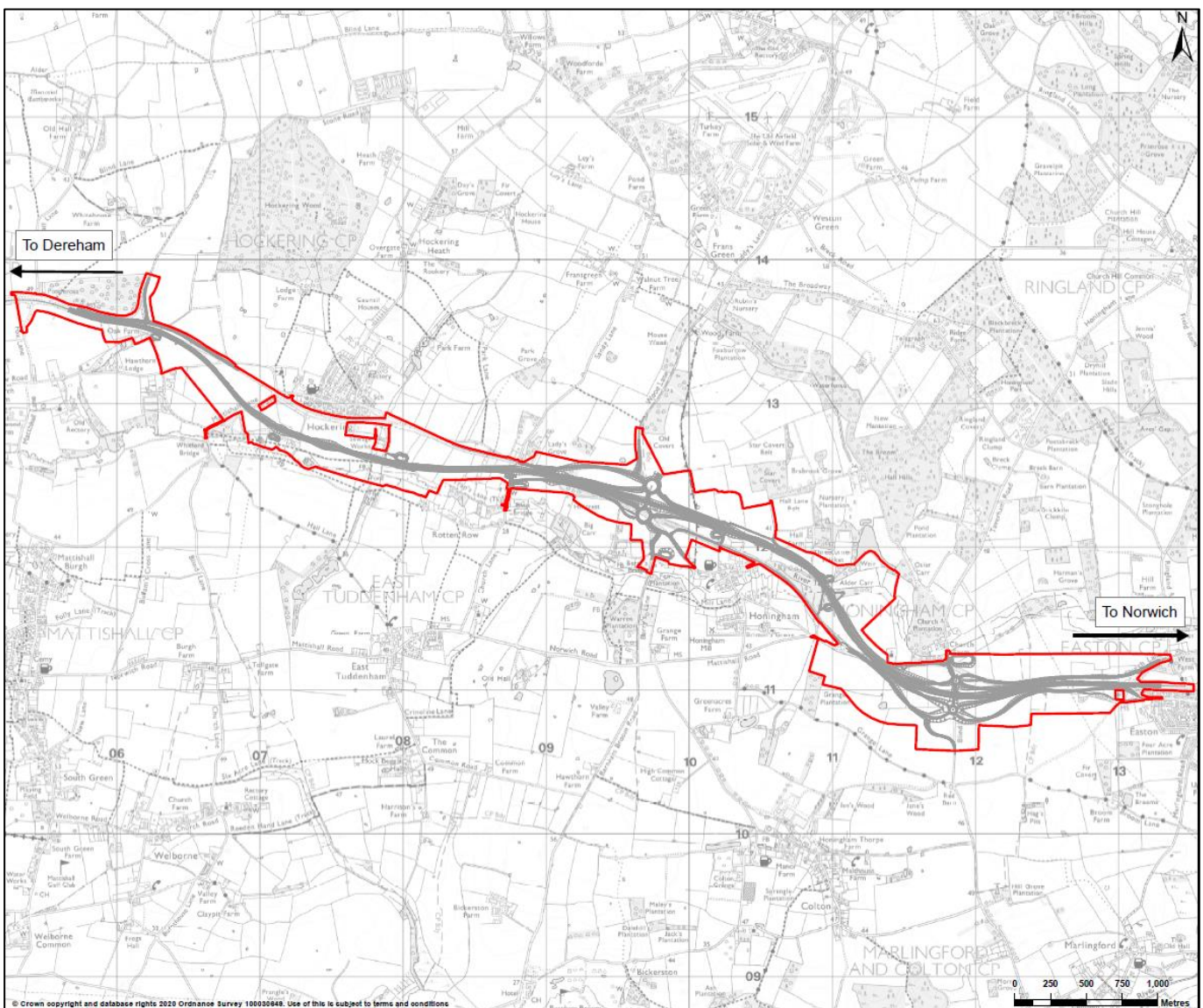
- 2.3.1. The area surrounding the Proposed Scheme is predominately arable land enclosed by winding lanes and hedgerows, with pockets of ancient woodland and remnant heath cut through by pastoral river valleys. The broadly flat, rural



landscape is an ancient countryside with a long-settled agricultural character. The eastern scheme extents are more gently undulating relative to the broadly flat landscape of the western extents.

- 2.3.2. The Proposed Scheme is located between North Tuddenham and Easton where there is currently a section of single carriageway which is part of the main arterial highway route connecting Norwich and Great Yarmouth to the east (as shown on Figure 2.1).

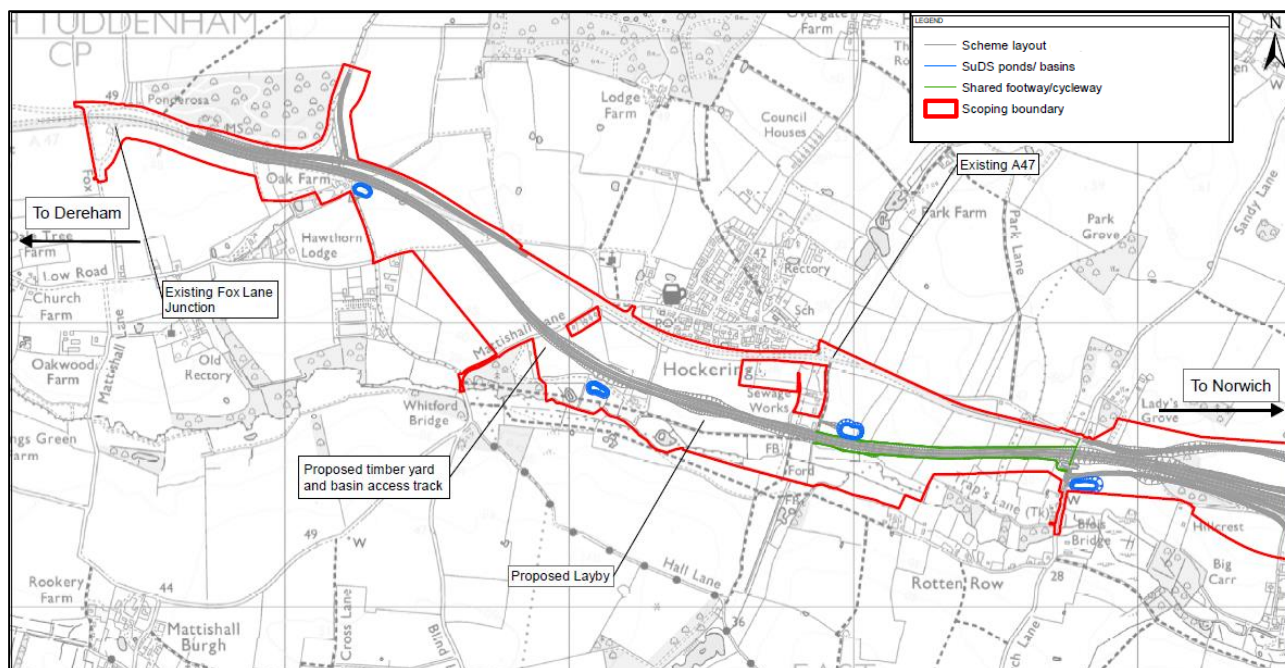
Figure 2.1: Site Location



- 2.3.3. The start of the Proposed Scheme is located east of North Tuddenham close to Oak Farm at National Grid Reference (NGR) TG 06067 13529. The route passes to the south of Hockering, and parallel to the River Tud. Woodland along the north and south bank of the River Tud are described as habitats of potential ecological importance in this area south of Hockering.



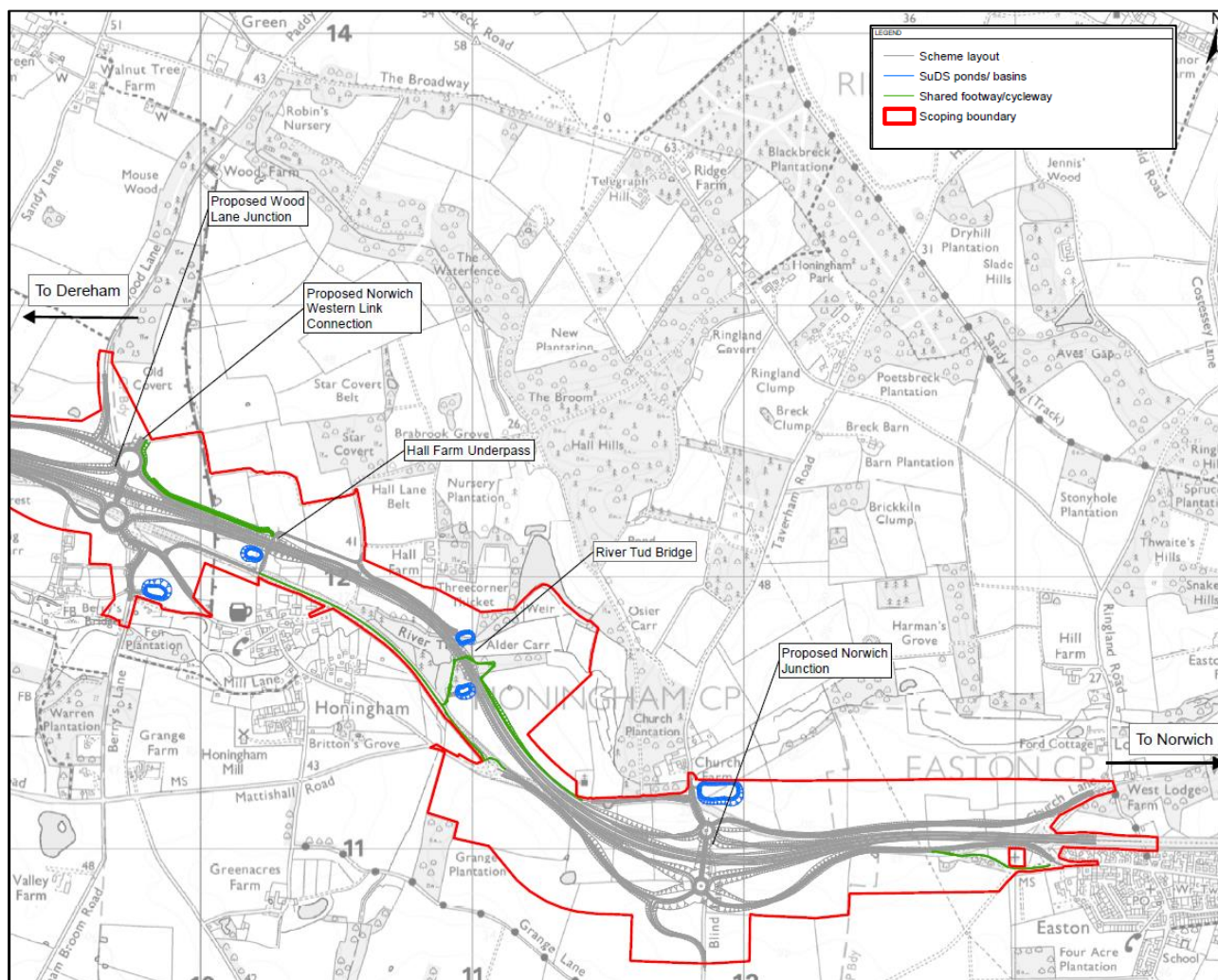
Figure 2.2 Proposed scheme layout



- 2.3.4. The Proposed Scheme then crosses north of the current A47 at Church Lane and Sandy Lane where a connection to the Norwich Western Link Connection is provided. The proposed route then follows an offline route<sup>1</sup> to the north side of the current A47 and then north east of Honingham. Close to this area are four woodland areas of potential ecological importance, within low lying agricultural land. East of Honingham the proposed route will make a perpendicular crossing of the River Tud.
- 2.3.5. The Proposed Scheme continues to run south and then north of the current A47 alignment before joining the current dual carriage way at Easton at NGR TG 13102 11028. The Church of St Andrew (north of the Proposed Scheme) and Church of St Peter (south of the Proposed Scheme) are adjacent to the current A47 and the proposed route. A junction is proposed between Blind Lane, Taverham Road and the current Easton roundabout. The Easton roundabout would be removed as part of the proposals.

Figure 2.3 Proposed scheme layout (eastern scheme extents)

<sup>1</sup> Offline refers to the road moving from the current alignment to a new alignment



## 2.4. Description of the scheme

### 2.4.1. The Proposed Scheme consists of the following elements:

- 9km of new dual carriageway, running to the south of the existing A47 at Hockering and to the north of the existing A47 at Honingham
- two new grade-separated junctions where the A47 passes over the local roads at the intersections of Berry's Lane with Wood Lane (Wood Lane junction) and Blind Lane with Taverham Road (Norwich Road junction)
- removal of the existing roundabout at Easton to create a free-flowing dual carriageway
- three bridges carrying the A47 over the River Tud and the proposed Wood Lane and Norwich Road junctions
- closing the existing Church Lane and Sandy Lane connection to the A47 with new sideroads providing access to Wood Lane junction

- retaining sections of the existing A47 for local road connections and new routes for walkers, cyclists and horse riders where possible, with abandoned sections to be landscaped
- constructing a new underpass for walkers and cyclists to the west of the proposed Norwich Road junction keeping north – south connectivity
- a new route for walkers and cyclists linking Honingham with St Andrews Church
- a new connection to maintain the north – south route from Honingham towards Weston Green, as the proposed Wood Lane junction cuts across an existing restricted byway
- new drainage systems, including pollution control devices. These are illustrated in the PEIR
- diversion of some utilities infrastructure such as gas mains if needed
- two new laybys on the A47 between Fox Lane and the proposed Wood Lane junctions
- a site compound, storage areas and temporary vehicle parking located within the proposed scheme boundary when construction is taking place

2.4.2. The new mainline dual carriageway aims to improve safety along this part of the A47 road, the current road is already at capacity and there are 14 collisions a year on average. The new road section will increase capacity and so make journey times more reliable for the public and businesses.

## 2.5. Roads

### Main dual carriageway

- 2.5.1. The new mainline dual carriageway will be predominantly offline with exceptions at the route tie ins at Fox Lane to the west and Easton to the east.
- 2.5.2. After the Fox Lane junction the mainline gradually moves offline to the south of the existing A47, passing Hockering approximately 200m further south than the existing road. After Hockering, the mainline gradually sweeps north, crossing the existing A47 between the Sandy Lane and Wood Lane sideroads. The first of the two grade separated junctions, Wood Lane junction, is located where the existing Wood Lane and Berry's Lane meet. From this junction the mainline runs largely parallel to the existing A47 to the north, passing just above existing areas of woodland. The mainline crosses the River Tud before passing back over the existing A47 south of St Andrew's Church. The second of the two grade separated junctions, Norwich Road junction, is then located south of the existing staggered junction of Taverham Road and Blind Lane. The mainline then crosses back over to the north side of existing A47 before tying into the existing dual carriageway section at Easton.

- 2.5.3. As part of the overall route strategy to improve safety and reliability there will be no direct access provided onto the mainline A47 dual carriageway once operational other than at the grade separated junctions.
- 2.5.4. Two new lay-bys shall be provided on the route, one eastbound and one westbound. The exact location of these lay-bys is to be refined but both will sit south of Hockering.

### **Grade separated junctions**

- 2.5.5. Two new grade separated junctions will provide road users with connections to the existing local road network and access to adjacent towns and villages.
- 2.5.6. The two junctions will take the form of a dumbbell junction configuration. Wood Lane Junction is located where the existing Wood Lane and Berry's Lane meet, and the Norwich Road Junction located close to where the existing Taverham Road and Blind Lane meet. At both junction locations roundabouts will be located north and south of the mainline to enable road users to leave or join the mainline and access the local sideroad network.
- 2.5.7. Both junctions are positioned in cutting with the mainline rising up on embankment in order to provide sufficient clearance between the mainline and links between the proposed roundabouts.
- 2.5.8. The Norwich Western Link (NWL) scheme, promoted by Norfolk County Council, will be connected to the A47 via the Wood Lane junction. An additional lane on the eastbound diverge on the A47 will be provided to accommodate for traffic coming from the west and heading north on the NWL.
- 2.5.9. The existing roundabout located at Easton will be removed as part of the works. The existing sideroads connecting into this roundabout will be diverted with new links to Norwich Road Junction provided to maintain connectivity.

### **Side roads and accesses**

- 2.5.10. As part of the overall route strategy to improve safety and reliability there will be no direct access provided onto the mainline other than from the grade separated junctions. As a result of this a number of existing sideroads and accesses that currently have direct access onto the A47 will be severed as part of the works and will be realigned to tie into proposed new grade separated junctions (as shown on Figure 2.1).

### *Existing A47 between Fox Lane and Hockering*

- 2.5.11. A new connection between North Tuddenham and Hockering will be provided by a new link road between the existing B1147 east of North Tuddenham and the



existing A47. A new priority junction that will result in the east/west movement becoming the priority over the north/south movement to and from the village of Lyng.

#### *Low Road*

- 2.5.12. The existing Low Road will be severed as a result of the new dual carriageway. Road users will be required to use the existing and proposed road network via the Fox Lane junction to travel between Hockering and destinations west of the proposed severed Low Road.

#### *Mattishall Lane*

- 2.5.13. The existing Mattishall Lane will be severed as a result of the new dual carriageway. Road users will be required to use the existing road network with a diversion route via the Fox Lane junction.

#### *Mill Lane*

- 2.5.14. The existing Mill Lane, which provides access to an existing business, will be severed. A new access track will be provided from Mattishall Lane.

#### *Church Lane*

- 2.5.15. The existing Church Lane will be severed as a result of the new dual carriageway. A new link will be provided between Church Lane and the proposed Wood Lane Junction southern roundabout to enable road users to maintain access.

#### *Existing A47 between Church Lane and Wood Lane*

- 2.5.16. The existing A47 providing road users with a link between Honingham and Hockering will be severed as a result of the new dual carriageway. To maintain access between the two destinations a new link road will be provided between the existing A47 at Church Lane and the proposed Wood Lane junction northern roundabout.

#### *Wood Lane*

- 2.5.17. As a result of the new grade separated junction at Wood Lane the existing road will be realigned slightly to the west and a new priority junction will be created on the new link between Church Lane and the Wood Lane junction northern roundabout.

### *Dereham Road*

- 2.5.18. As a result of the new grade separated junction at Wood Lane the existing road will be realigned slightly and will now tie into the proposed Wood Lane junction southern roundabout.

### *Berry's Lane*

- 2.5.19. Berry's Lane which currently ties into the existing A47 will be realigned and will tie into Dereham Road east of the proposed Wood Lane junction southern roundabout via a new priority junction.

### *Hall Farm Access*

- 2.5.20. As part of the realigned A47 the existing private access to Hall Farm will be severed. A new access track will be provided, together with an underpass below the new dual carriageway, to tie in with the existing A47. In addition, a new link will be provided between the realigned Dereham Road and the existing A47 to provide a route between Hall Farm and Wood Lane Junction.

### *Existing A47 east and west of St Andrew's Church*

- 2.5.21. The existing A47 immediately west of St Andrew's Church will be severed as a result of the realigned dual carriageway. To maintain local access, a new link shall be provided between the existing roundabout on the A47 to the east of Honingham and the southern roundabout at the proposed Norwich Road Junction. This will provide connectivity for Honingham and surrounding communities to the east.
- 2.5.22. A short connection shall also be provided between the existing A47 at St Andrews Church and Taverham Road to maintain connectivity.

### *Blind Lane*

- 2.5.23. Blind Lane shall be realigned slightly south of the southern roundabout at the proposed Norwich Road Junction. Blind Lane will connect to the existing roundabout on the A47 and the southern roundabout at the proposed Norwich Road junction via a new link road.

### *Existing A47 Between Blind Lane and Easton*

- 2.5.24. The Proposed Scheme severs the existing A47 between Blind Lane and the roundabout at the intersection of Church Lane and Dereham Road. To maintain connectivity, links shall be provided both north and south of the new mainline dual carriageway. A new link shall be provided from the proposed roundabout at Taverham Road to tie in with Church Lane. An additional link is proposed from

Blind Lane and will tie in with Dereham Road south of the existing roundabout at the intersection of Church Lane and Dereham Road.

*Fencing, barriers and road signage*

- 2.5.25. Boundary fencing will be provided to delineate the highway boundary.
- 2.5.26. A safety barrier will be provided in the central reserve between the two carriageways. Safety barriers will be provided in the verge where required following an appropriate assessment of hazards along the length of the route.
- 2.5.27. New road signage will be provided on the new mainline as well the local sideroad network to provide road users with the necessary advance warning.

## 2.6. Structures

### 2.6.1. The proposed structures associated with the Scheme are described within Table 2.1.

Table 2.1: Proposed Scheme structures

Structure	Description
East Culvert	A new culvert will be constructed to carry an unnamed tributary of the River Tud below the mainline. This structure will be a 54m long box culvert formed of precast units. The box culvert has an internal width of 1.5m and height of 1.5m.
Church Lane Underpass	A new underpass will be constructed below the mainline on the existing Church Lane. This underpass will serve pedestrians and cyclists only and will be a 41m long in situ concrete box culvert. The box culvert has an internal width of 4.0m and height of 3.0m. Splayed in situ wingwalls will tie the culvert into the embankment.
Wood Lane Junction Underbridge	A new underpass will be constructed as part of the new grade separated Wood Lane Junction. This structure will be a 27m long in situ concrete portal with a clear span of 15.3m. Splayed in situ concrete wingwalls will tie the portal into the embankment.
Hall Farm Access Underpass	As part of the realigned A47 the existing private access to Hall Farm will be severed. A new underpass below the mainline will therefore be provided to maintain access. The structure will also accommodate a segregated shared pedestrian and cycle facility on the west side of the structure which will serve to maintain existing north/south connectivity. This structure will be a 32m long in situ concrete box culvert. The box culvert has an internal width of 6.5m and height of 4.5m. Splayed in situ concrete wingwalls will tie the culvert into the embankment.
New River Tud Bridge	The proposed new mainline dual carriageway crosses the River Tud east of Honingham. A new crossing will therefore be provided over the River Tud. The structure will be a fully integral portal frame underbridge using pre-stressed concrete beams and a reinforced concrete deck. The structure will have a clear span of 14.0m, a width of 27.8m and a skew of 20 degrees. Splayed in situ concrete wingwalls will tie the structure into the embankment where possible, the east wingwall will run parallel to the main carriageway due to the proximity of the River Tud.
St. Andrew's Church Retaining Wall	The proposed new mainline rises up on embankment on the approach to Norwich Road Junction in order to provide sufficient clearance for the underbridge as part of the Norwich Road grade separated junction. The new mainline has been moved slightly south and away from St. Andrew's Church but as a result of the mainline being on embankment a retaining wall will be required adjacent to minimise the impact of earthworks and maintain access. The in situ retaining wall will be approximately 2.0m in height and 70m long.
Norwich Road Junction Underbridge	A new underpass will be constructed as part of the new grade separated Norwich Road Junction. This structure will be a 33m long in situ concrete portal with a clear span of 14.55m. Splayed in situ concrete wingwalls will tie the portal into the embankment.
New West Culvert	A new culvert will be constructed to carry an unnamed tributary of the River Tud below secondary road. This structure will be a 43m long concrete pipe culvert with an internal diameter of 825mm, headwalls will be formed by precast concrete units.
Existing West Culvert Extension	An extension to the existing S08 West Culvert will be constructed to carry an unnamed tributary of the River Tud below the realigned and widened mainline. This structure will be a 17m long concrete pipe culvert with an internal diameter of 825mm, headwall will be formed by precast concrete units.
River Tud Culvert	A new culvert will be constructed to carry an unnamed tributary of the River Tud below the mainline. This structure will be a 76m long concrete pipe culvert with an internal diameter of 750mm, headwalls will be formed by precast concrete units



## 2.7. Lighting

- 2.7.1. The two grade separated junctions at Wood Lane and Norwich Road will be lit. However, it is not proposed that the dual carriageway and side roads will be lit. Full lighting plans will be developed as the Proposed Scheme progresses.

## 2.8. Drainage

- 2.8.1. The proposed drainage strategy will retain existing drainage systems where they will be unaffected by the Proposed Scheme and utilise the existing outfalls where possible.
- 2.8.2. The new drainage system will meet design criteria of no flooding for a one in five-year event plus an additional 20% to allow for climate change. In the case of roads that shall be adopted and maintained by Norfolk County Council, the drainage system shall have no flooding for a one in 30-year event plus an additional 20% to allow for climate change. This shall be extended to one in 50-year event plus an additional 20% climate change allowance for the low points in the carriageway alignment.
- 2.8.3. Where road realignment is required, existing drainage will be relocated to match the new road alignment. Side road links at the tie-ins will connect into existing drainage system pending surveys of the existing drainage systems to assess their suitability.
- 2.8.4. Drainage surveys will be undertaken to confirm where existing drainage would be severed and if connections would be required into new drainage networks. Assumptions made during the design shall be revised pending confirmations from the drainage surveys with the final design being updated as required.
- 2.8.5. At structures, deck drainage and back of wall drainage systems will be provided and will be required to outfall to a drainage system or a suitable soakaway provision.
- 2.8.6. Runoff from the carriageway will be attenuated to greenfield runoff values at each of the identified outfall locations along its length. Attenuation shall be in the form of attenuation basins. The basins shall incorporate shut off facilities e.g. penstocks, to allow for the containment and removal of spillages. Outfall locations and routes will be identified following drainage surveys.
- 2.8.7. Basins shall be located outside of flood zones where possible. Where any encroachment into flood zones is necessary compensatory storage may be provided.

- 2.8.8. Outlet areas are designed to attenuate peak discharge rates up to a one in 100-year event plus an additional 20% climate change allowance. A sensitivity check will be made using a 40% climate change allowance.
- 2.8.9. Where kerbs are present, these sections of carriageway shall be drained via combined kerb units or a kerb and gulley system, discharging to filter drains or carrier drains located in the verges.
- 2.8.10. Filter drains shall be provided in the verge along the mainline when in cutting, this shall collect the run-off from the carriageway, verge and the adjacent cut slopes. Where the road is on embankment, a concrete channel and below verge carrier system shall be used. Where the road is in super elevation central reserve drainage shall be provided in the form of concrete channels, kerb and gulley or a kerbed drainage system, out falling to a carrier drain system in the central reserve.
- 2.8.11. Where the mainline is on embankment, toe drains are to be provided when over the edge drainage provision can be used this would be in the form of ditches where levels allow it to connect to the main drainage system for attenuation.
- 2.8.12. Natural overland runoff and existing ditches / streams between the existing A47 and the proposed new mainline, will be intercepted by new ditches and conveyed along the natural drainage path as far as possible. This will involve pipe crossings of the proposed new mainline. Additional measures (e.g. soakaways) may be required at the outfall where a defined link cannot be met with existing flow pathways.

## **2.9. Alternatives considered**

- 2.9.1. Fourteen potential options were developed and assessed in 2017 to identify their performance against environmental, engineering, transportation and economic criteria so that they could be compared and contrasted to allow the most appropriate options to be taken forward.
- 2.9.2. The Preferred Route Announcement in 2017 concluded that four of these options solved the transportation problem by providing a dual carriageway link which will improve the traffic flow, reduce journey times on the route and increase the route safety and resilience.
- 2.9.3. These options are described in the Scoping Report a copy of which can be accessed via the following link:
- 2.9.4. <https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/projects/TR010038/TR010038-000028-TUDD%20-%20Scoping%20Report.pdf>

## **Preferred route announcement**

- 2.9.5. The preferred route was announced in August 2017 and Option 2 was chosen. More information on the Preferred Route Announcement can be found at:  
[www.highwaysengland.co.uk/A47NT-E](http://www.highwaysengland.co.uk/A47NT-E)

## 3. Consultation

### 3.1. EIA Scoping report

3.1.1. A Scoping Report was submitted to the Planning Inspectorate on 23 September 2019. The resulting Scoping Opinion from the Planning Inspectorate with consultee responses was received by Highways England on 01 November 2019, a copy of which can be accessed via the following link:

3.1.2. <https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR010038/TR010038-000032-TUDD%20-%20Scoping%20Opinion.pdf>

### 3.2. Engagement with hard to reach groups

- 3.2.1. It is anticipated that the Proposed Scheme's Equality Impact Assessment undertaken will identify the relevant hard to reach groups. During the previous stage of the project, an Equality Impact Assessment was undertaken. The conclusions identified that the impact on the various equality groups was not known at that time and will require further data gathering and analysis to be undertaken prior to a conclusion being drawn.
- 3.2.2. Host local authorities will be consulted about identification of relevant groups. Categories identified and contacted include walker, cyclist and horse rider groups, organisations that work with specific groups, local Traveller communities', disability groups and groups representing children and the elderly.
- 3.2.3. Policy guidance documents and other relevant technical documents will be available online and at various information points stationed at local community venues. These documents will be added to throughout the course of the project. The project web site address is:

<https://highwaysengland.co.uk/projects/a47-north-tuddenham-to-easton-improvement-scheme/>

## 4. Air quality

### 4.1. Introduction

- 4.1.1. This chapter presents the preliminary findings of the air quality assessment. This comprises a review of the existing environment and identification of potential impacts of the Proposed Scheme upon surrounding air quality. The assessment has been undertaken following the relevant policy and legislation and latest guidance.

### 4.2. Assumptions and limitations

- 4.2.1. Assessment work to date has been undertaken qualitatively as traffic data for the Proposed Scheme are not available. The assessment work to date has been based on an understanding of baseline conditions, location of sensitive receptors and potential changes to the impact at these sensitive receptors due to road layout.

### 4.3. Methodology

#### Construction

- 4.3.1. Key stages of the construction phase alongside the location and types of sensitive receptors will be identified in accordance with DMRB 207/07.

#### Operation

- 4.3.2. DMRB Volume 11, Section 3, Part 1 LA 105 and Defra's Local Air Quality Management Technical Guidance (LAQM.TG(16)) will be used to:
- Identify the level of assessment required and provide full justification in the ES. This will be based on the risk level of the scheme as well as the receiving environment.
  - Produce an Affected Road Network (ARN) using the method outlined in section 4.4.2.
  - Verify model outputs with local measurement data.
  - Prediction of annual mean NO<sub>2</sub> concentrations at both sensitive receptors and designated ecological sites in the 'Baseline', 'Do-Minimum' and 'Do-Something' scenarios.
  - Predict annual mean PM10 concentrations to determine if further assessment is required following the method outlined in DMRB LA105.
  - Determining significant effects in accordance with DMRB LA 105

## 4.4. Baseline

### Study area

- 4.4.1. The study area will be defined once the ARN has been identified following the traffic modelling. This shall be included in the ES detailing how the study area was defined and the traffic reliability area (TRA) appropriate for the air quality assessment. It will include human health receptors and ecologically designated sites within 200m of roads that are expected to be affected by the Proposed Scheme.
- 4.4.2. The Affected Road Network is defined under DMRB Volume 11, Section 3, Part 1, LA 105 Air Quality where:
- a change in carriageway alignment by  $\geq 5$ m Road alignment will change by 5m or more
  - annual Average daily Traffic Daily traffic flows will change by 1,000 Annual Average Daily Traffic (AADT) or more, or  $\geq 1,000$
  - heavy Duty Vehicle (HDV) flows will change by  $AADT \geq 200$  AADT or more
  - a change in speed band
  - air quality construction impacts are expected to be restricted to within 200m of construction activities (as stated in DMRB Volume 11, Section 3, Part 1)

### Survey and desk-based information

#### *Existing baseline information*

- 4.4.3. For this report, the most recent ratified data (2018) has been obtained from the Local Authorities that the Proposed Scheme passes through (Breckland Council, Broadland District Council and South Norfolk Council), Department for Environment, Food and Rural Affairs (Defra), and Highways England.

#### *Air quality management areas (AQMA)*

- 4.4.4. In June 2017, an AQMA was declared in Swaffham for exceedances of the annual mean of NO<sub>2</sub>. This is approximately 24km west of the site and is not expected to be impacted upon as a result of the Proposed Scheme.
- 4.4.5. There are currently no AQMAs declared in the Broadland Council or South Norfolk Council boundaries.
- 4.4.6. The nearest AQMA to the Proposed Scheme is the Central Norwich AQMA approximately 9km east declared by Norwich City Council, the Proposed Scheme does not fall within the Norwich City Council authority boundary. This AQMA is not expected to be impacted upon by the Proposed Scheme.

### *Local Authority monitoring*

- 4.4.7. There are no automatic monitoring sites within Broadland District Council or South Norfolk Council boroughs. However, Breckland Council undertakes continuous automatic monitoring at two sites. The monitoring sites are located at East Wretham and Swaffham and therefore neither are considered to be representative of the study area.
- 4.4.8. Breckland Council, Broadland Council and South Norfolk Council undertake diffusion tube monitoring for NO<sub>2</sub> within their respective borough's. However, there are no diffusion tubes representative of air quality within the study area of the Proposed Scheme. The nearest local authority diffusion tube monitoring location is South Norfolk roadside monitoring location DT27, which measured an annual mean concentration of 23.6 µg/m<sup>3</sup> in 2018.

### *Additional baseline data*

- 4.4.9. Highways England have commissioned a NO<sub>2</sub> diffusion tube monitoring survey which commenced in October 2019. The monitoring consists of seven locations adjacent to the proposed route in rural, roadside and background locations. Annualised data is currently unavailable however, full details of the monitoring data will be available for the production of the ES. The monitoring locations are outlined in Table 4.1 below.

Table 4.1 : Monitoring locations

Site ID	Description	X	Y
Tuddenham 1	A47 cycle path sign opposite low road	606758	313299
Tuddenham 2	A47 speed camera post at Sandy Lane	608783	312603
Tuddenham 3	A47 roundabout at Norwich Road, lamppost at roundabout western arm approach	611063	311331
Tuddenham 4	A47 on solar post at parking layby to the west of hall drive	610263	311985
Tuddenham 5	Residential receptor closer to proposed new road alignment, Church Lane, telegraph pole opposite church lane house	608735	312359
Tuddenham 6	Low Road A47 Junction give way sign post	606738	313295
Tuddenham 7	Telegraph pole at Blind Lane. Previous monitoring location, Tuddenham C. Across from Taverham Road	611830	311145

### *Defra background concentrations*

- 4.4.10. In addition to the data collected from the monitoring survey, Defra provides estimates of background pollution annual mean concentrations for NO<sub>x</sub>, NO<sub>2</sub> and

PM<sub>10</sub> across the UK for each 1km grid square, for every year from 2017 to 2030. The background maps future year projections have been based on the year 2017.

- 4.4.11. The maps include a breakdown of background concentrations by emission source, including road and industrial sources which have been calibrated against 2017 UK monitoring data.
- 4.4.12. At this time, it has not been confirmed whether the baseline year will be 2018 or 2019. This will be dependent on the availability of the latest approved measurement data. The choice of background year will be in line with the baseline assessment year. The ES will provide full details of the background concentrations used.

#### *Pollution climate mapping concentrations*

- 4.4.13. Defra's Pollution Climate Mapping (PCM) is used to report compliance with the EU limit values and provides NO<sub>2</sub> concentrations for a number of roads across the UK for a selection of future years. The most up to date PCM model outputs are based on a 2017 baseline year, following the release of Defra's Air Quality Action Plan.
- 4.4.14. Based on projected roadside NO<sub>2</sub> concentrations in the current version of the PCM model, there are no PCM links within 15km of the Proposed Scheme exceeding 40µg/m<sup>3</sup> for the year of 2017. The closest PCM link (on the A1074) is located approximately 5km from the Proposed Scheme and has a reported annual mean NO<sub>2</sub> concentration in 2017 of 29.4µg/m<sup>3</sup>, which is well below the annual mean limit value of 40µg/m<sup>3</sup> for NO<sub>2</sub> and therefore the Proposed Scheme is unlikely to cause a non-compliance with the Air Quality Directive.

## **4.5. Consultation**

- 4.5.1. Further to the consultation already undertaken as part of Scoping, discussions with Broadland District Council, South Norfolk Council and Breckland Council will be undertaken on the choice of receptors included in the assessment, once the affected road network is defined.

## **4.6. Scheme considerations**

### **Potential impacts**

#### *Construction*

- 4.6.1. An indicative construction assessment will be undertaken following best practice guidance using a risk-based approach which considers the dust raising potential of the likely construction activities, the embedded mitigation and the location of



potentially sensitive receptors. Implementation of appropriate site-specific mitigation will reduce the impact on air quality.

### *Operation*

- 4.6.2. The redistribution of road traffic as a result of the Proposed Scheme will likely have an impact on the surrounding air quality. This is all dependant on where the changes in traffic flow occur.
- 4.6.3. The Proposed Scheme will result in the road alignment moving further away from the receptors within the village of Hockering. This is the same for the receptors in the village of Honingham, resulting in a potentially beneficial impact. A potential detrimental impact could occur at the residential receptors located in Church Lane, where the Proposed Scheme will result in the road alignment moving closer to the sensitive receptors. However, the actual impact will only be determined by conducting a full dispersion modelling study.

## **Potential mitigation**

### *Construction*

- 4.6.4. At this time, it is unknown if additional mitigation measures are required during the construction phase other than those stated in accordance with Best Practicable Means (BPM) which would be incorporated into the CEMP.

### *Operation*

- 4.6.5. Currently there have been no operational air quality specific mitigation measures designed for the Proposed Scheme. Operational mitigation will be reported in the ES once full air quality modelling has been conducted.

## **4.7. Summary**

- 4.7.1. This chapter has summarised the current understanding of the baseline conditions. A review of existing background data suggests that air quality is generally good and significantly below the annual mean air quality objective for NO<sub>2</sub>.
- 4.7.2. The appropriate level of assessment will be undertaken as per the guidance in DMRB LA105.
- 4.7.3. The Proposed Scheme is predicted to impact the air quality at sensitive receptors adjacent to the A47 due to traffic flows redistributing and changes to the road alignment. A review of the likely road alignment changes associated with the Proposed Scheme suggests there is potential for both a positive and

negative impact on air quality, however this will be determined by conducting a full dispersion modelling study.

- 4.7.4. Construction and operational mitigation will be reported in the ES alongside detailed baseline conditions and the changes likely to occur during the construction and operational phase at all identified sensitive receptors within the study area.

## 5. Cultural Heritage

### 5.1. Introduction

- 5.1.1. This chapter consists of a review of the known heritage assets of the Proposed Scheme and the area around it. Potential unknown assets will be identified through the geophysical survey and trial trenching. Heritage assets can include archaeological finds and deposits, historic buildings and historic landscapes. The impact of the Proposed Scheme on heritage assets is outlined below. The chapter identifies design measures to mitigate any potential impacts and summarises relevant consultation undertaken in relation to the Proposed Scheme.

### 5.2. Assumptions and limitations

- 5.2.1. At the time of reporting, a geophysical survey is underway, the results of which will be outlined in the ES. Archaeological trenching will be undertaken. A full walkover survey will be undertaken to inform the ES. Therefore, the value and sensitivity of known heritage assets and the potential for previously unknown assets within the area of the Proposed Scheme is not fully understood at this stage.
- 5.2.2. Desk-based information sources used for the scoping report were summaries of previous archaeological works in the study area, meaning original copies of survey reports, archive mapping and historic aerial photographs were not available for this report.
- 5.2.3. Documentary sources are rare before the medieval period, and many historic documents are inherently biased. Older original sources often do not accurately locate archaeological sites and interpretation can be subjective. A precautionary approach should be used in the interpretation of archaeological assets identified from aerial imagery without archaeological excavation or supporting evidence (i.e. in the form of findspots, documents or survey data).
- 5.2.4. Information provided by County Council maintained Historic Environment Records (HER) can be limited or skewed due to the location of where research work has been done (i.e. previous construction schemes or academic research). Undiscovered heritage assets may be located within the study area due to previous investigation priorities not being located within the study area.
- 5.2.5. The impact assessment presented in this chapter is based on Design Fix A. Future changes to the Proposed Scheme might alter the predicted impacts on heritage assets. Any changes to the design will be outlined in the ES and will require further engagement with relevant stakeholders.

- 5.2.6. A Zone of Visual Influence (ZVI) will be produced as part of the Landscape Visual Impact Assessment (LVIA) in the ES and therefore used in the Cultural Heritage chapter to inform assessment of visual impacts to the settings of assets.

### 5.3. Methodology

- 5.3.1. This chapter has been completed using the information gathered for the previous scoping study and considers comments from Norfolk County Council Environmental Services (NCCES).
- 5.3.2. Information on both designated and non-designated heritage assets was gathered for a 1km study area around the proposed site boundary from the following sources:
- Historic England's National Heritage List for England. Assets from this source have reference numbers starting with NHLE.
  - Norfolk Historic Environment Record. Assets from this source have reference numbers starting with MNF.
- 5.3.3. The above data sources were updated in November 2019. Several assets were better understood or had slightly altered locations but overall, no significant changes were noted.
- 5.3.4. The assessment of sensitivity/value and impacts has been prepared in accordance with DMRB LA104, *Environmental assessment and monitoring* and LA106 *Cultural heritage assessment*.

### 5.4. Baseline Study area

- 5.4.1. For this report, information on both designated and non-designated assets was gathered for 1km around the Proposed Scheme from the following sources:
- Historic England's National Heritage List for England. Assets from this source have reference numbers starting with NHLE.
  - Norfolk Historic Environment Record. Assets from this source have reference numbers starting with MNF.

#### Survey and desk-based information

##### *Designated assets*

- 5.4.2. There are no scheduled monuments, conservation areas, registered parks and gardens or historic battlefields within the study area.

- 5.4.3. There are 19 listed buildings within the study area, five of which are classified as grade I or grade II\* listed, as outlined in Table 5.1 and shown in Figure 5.1.

Table 5.1: Grade I and grade II\* listed buildings

Listed buildings	Description	Location
Grade I	Church of St Michael (NHLE 1077354)	250m to the north-east of the Proposed Scheme, at Hockering
	Church of St Mary (NHLE 1169192)	680m south of the western end of the Proposed Scheme
	Church of St Peter (NHLE 1305921)	30m to the south of the eastern end of the Proposed Scheme, at Easton
Grade II*	Church of St Andrew (NHLE 1170701)	50m to the north of the Proposed Scheme, east of Honingham
	West Lodge (NHLE 1050771)	880m to the north-east of the eastern end of the Proposed Scheme

- 5.4.4. There are 14 grade II listed buildings (Figure 5.2). Of the 14, the closest to the Proposed Scheme is the terrace of houses “39, 40 and 41, The Street” (NHLE 1170745), 100m to the south on the northern edge of Honingham. The rest are made up of post-medieval farmhouses, vicarages, houses and modern war memorials (i.e. Honingham and East Tuddenham War Memorial).

#### *Non-designated assets*

- 5.4.5. There are a number of non-designated assets identified across the study area ranging from prehistoric assets to post medieval and modern assets.
- 5.4.6. Based on comments received from NCCES, deposits of sand and gravel have been identified, specifically around the River Tud, and elsewhere; these have the potential to contain or located near significant, usually prehistoric, archaeological remains. Results from the boreholes and trial pits, undertaken as part of the geotechnical investigation, will potentially identify the locations and extent of sand and gravel deposits in order to guide further archaeological investigations.

Table 5.2: Non-designated assets

Non-designated asset timeline	Description	Location
Prehistoric (up to 43 ACE After Common Era)	The earliest remains identified within the study area are flint tools and flakes that have been found on the ground surface (Figure 5.1). <ul style="list-style-type: none"> <li>MNF35690</li> <li>MNF60470</li> </ul> Surface finds of cultural artefacts have usually been disturbed by ploughing but do show a potential for more remains nearby.	<ul style="list-style-type: none"> <li>MNF35690, north-east of Rotten Row, on the southern side of the A47</li> <li>MNF60470 east of Honingham, on the southern side of the A47</li> </ul>
	Bronze Age round barrow (a burial mound, usually with a ditch around the feature and with several human burials in and under it)	70m to the south of the A47, to the west of Easton (MNF59554)
	Bronze Age barrow cemetery	south-west of the barrow cemetery, around 430m to the south of the A47, south of Church House Farm
	One Iron Age toggle (a fastener for clothing or animal harness)	within the footprint of the Proposed Scheme (NHER 31498) at Sycamore Farm, north-east of Rotten Row
Roman (43 ACE to 410 ACE)	nearest known Roman town is at Caistor St Edmund, then called Venta Icenorum	12km to the south-east of the Proposed Scheme
	The area was anticipated to have been mainly rural, with possible field boundaries appearing as 'cropmarks' (which, along with parch marks, soil marks and frost marks can reveal buried archaeological sites not visible from the ground). The following cropmarks have been identified: <ul style="list-style-type: none"> <li>MNF59439</li> <li>MNF60178</li> </ul>	within the proposed site boundary
	surface finds that are anticipated to be part of a hypocaust (an under-floor heating system usually found in Roman villas and bath-houses) are recorded (MNF7304)	40m south of the Proposed Scheme area, between Hockering and Honingham
Early Medieval (410 ACE to 1066 ACE)	A small number of Saxon finds have been recorded within the study area, the closest known findspot is a Middle or Late Saxon set of tweezers (MNF29708) found through metal detecting.  They were found in the same field as the Roman cropmarks at MNF59439, hinting at a possible continued use of the site.	a field to the east of Honingham, 50m to the north of the Proposed Scheme
Medieval (1066 to 1540)	The villages of Hockering, Honingham, North Tuddenham and Easton are all recorded in the Domesday Survey of 1086, suggesting an earlier origin. Their churches (listed buildings) all date to the medieval period. It is anticipated that the land in between the villages was well-established agricultural fields at this time and earlier	Hockering, Honingham, North Tuddenham and Easton

Non-designated asset timeline	Description	Location
	Former medieval tofts (closely packed farms or houses) are known to have been present (MNF28552)	to the north of the Proposed Scheme, to the east of Honingham on the western side of Taverham Road
	Cropmarks (MNF53683) on a similar orientation have been recorded and might either be related to field boundaries or more tofts	a field to the south of MNF28552, within the footprint of the Proposed Scheme
Post Medieval and Modern (1540 to present day)	The study area remained rural in the post-medieval period. The major changes were the building of the turnpike between Norwich and Swaffham in 1775. This would mostly have been an improvement of an existing trackway and the modern A47 follows the route.	Along the route of the A47
	The modern road construction is likely to have removed the older road entirely except for where it bypasses town centres. There is a possibility that some parts of the older road would have been kept as a foundation for the new road. A milestone to the south of St Andrew's Church has survived since the 19th century (MNF56391).	Along the route of the A47
	Mapping from the late 18th century shows parkland for Honingham Hall (MNF44183). Remains of parkland are found in the form of field boundaries and landscape tree planting.	Crossing the proposed site boundary
	Some existing field boundaries are known from the historic OS mapping to date to the 18th and 19th centuries or earlier. The landscape today has seen many changes to remove boundaries and merge fields, meaning its character is now mainly 20th century agricultural fields. The available later historic period OS mapping show that the landscape has been relatively unchanged except for loss of some field boundaries and growth of the towns during the 20th century. There are also areas of managed wetland along the course of the River Tud and pockets of woodland surviving along the valley sides that might be older	Across the Proposed Scheme
Palaeo-environmental (waterlogged archaeological remains)	Peat deposits provide conditions which are suitable for preservation of organic remains that would not usually survive when exposed to the open air, such as wood, leather, string, hair and skin. Peat was found in two geotechnical boreholes (TG11SW/106 and TG11SW/107).  This is recorded as patchy and may not extend to the proposed site boundary. Further interpretation of targeted boreholes will be required to fully understand the palaeo-environmental potential of the proposed site boundary.	close to the River Tud 270m to the south of the A47 at Honingham

## Future surveys

5.4.7. The following surveys will be undertaken in 2020 and used to inform the cultural heritage chapter of the ES:

- Further archive research at the Norfolk Historic Environment Record, Norfolk Archives, Historic England's aerial photography collections and Lidar data from the Environment Agency.
- Site visits, of the footprint of the Proposed Scheme in general and to assess specific assets for detailed setting assessments
- Boreholes and trial pits for geotechnical purposes will be reviewed to assess the possibility of deposits like sand, gravel and peat that might hold archaeological deposits
- Archaeological geophysical survey (magnetometry)
- Archaeological trial trenching
- Data already gathered will be updated as appropriate based on the refined footprint of the Proposed Scheme, the ZVI and to inform impact assessments as needed. Consultation with Norfolk Historic Environment Record will be undertaken regularly to ensure the data is up to date.

5.4.8. The information gathered will be collated into a specialist appendix of all desk-based information, along with full copies of all archaeological fieldwork done for the scheme.

## 5.5. Consultation

5.5.1. The Scoping Opinion was received in October 2019. The responses are summarised in Table 5.3 and will be addressed within the ES.

Table 5.3: Cultural Heritage scoping responses

Site ID	Description
Historic England	Noted the potential for significant harmful effects on designated heritage assets. Recommended a cultural heritage chapter and specialist appendices for supporting information. Noted the potential for setting impacts on the grade I churches and the grade II* farmhouse at church farm. Suggested that impact assessment for the settings of cultural heritage assets could include photomontages, wireframe models etc., and should not be limited to purely visual impacts. In presenting the impacts on setting, they reinforced that this is often a matter of expert opinion and narrative-led rather than strict matrix-led assessment and that the wording of the National Planning Policy Framework in terms of benefit, loss and harm should be used as a guide.
Norfolk County Council	Noted that several types of geological deposit in addition to peat indicate potential for archaeological remains. Requested a pre-DCO application geophysical survey as a minimum and possibly trenching following survey results.
Hockering Parish Council	Requested clarification on the definition of the "historic park"



Site ID	Description
Planning Inspectorate	Noted that Norfolk County Council and Historic England should be consulted to determine if any assets further away than 1km should be included. Stated that the Zone of Influence should be agreed with Historic England and Norfolk County Council. Requested that buildings of local importance be assessed in the ES, following consultation of the relevant authorities. requested that the extent of the "historic park" be illustrated in the ES. Requested that the results of field survey be incorporated into the assessments in the ES.

- 5.5.2. In addition, informal discussions with NCCES have identified archaeological investigations adjacent to the Proposed Scheme that have been recently completed but not yet been made fully available to the public. These results will be used to inform the ES, where possible. The NCC HER will be visited to view copies of reports, maps and aerial photos.

## 5.6. Scheme considerations

### Potential impacts

- 5.6.1. Physical impacts on heritage assets may happen as a result of the following activities during pre-construction and / or construction, within areas of temporary or permanent land-take. The below list outlines potential impacts which will be detailed further for the ES:

- demolition, site clearance and ground preparation
- excavation, ground disturbance and compaction
- vibration from plant and machinery
- building up site levels with made-ground
- diversion / alteration of existing services or installation of new services
- landscaping and planting
- constructing new infrastructure or modification of existing infrastructure

- 5.6.2. Indirect impacts on heritage assets may arise as a result of the following activities during construction or operation:

- visual and noise intrusion, including from vehicle movements and lighting
- airborne dust and exhaust fumes

- 5.6.3. These activities could lead to the following effects on the historic environment:

- damage or long-term burial of archaeological remains
- structural damage to historic buildings
- severance or loss of features in a way that our ability to understand and appreciate the remaining elements is lessened
- alteration of the historic setting of an asset

- effects on the access to, and use of, an asset
- cumulative effects are also a consideration and will be reported in the ES.

5.6.4. The Proposed Scheme may also present opportunities for the enhancement of the historic environment. These opportunities could come from design elements or from mitigation design and might include:

- long-term preservation of heritage assets
- restoration of setting of heritage assets
- improved access or public appreciation of the heritage of the area
- improved opportunities for tourism including assets

5.6.5. There will be an unavoidable impact on the setting of the grade I listed St Peter's Church and St Andrew's Church given the proximity to the junction improvements at Church Lane and Taverham Road. During design development, mitigation measures to reduce this potential impact will be investigated.

5.6.6. Predicted impacts to known archaeological and paleoenvironmental assets remains a possibility. However, the significance of this will be assessed within the ES. The programme of mitigation will aim to avoid or reduce impacts by design if desirable and practicable.

5.6.7. Cultural heritage improvements often have associated economic benefits, such as increased investment in business, local shopping or increased productivity (as cited by Historic England "Heritage and the Economy", 2019). Where such enhancement opportunities are identified, they will be reported in the ES in terms of positive heritage impacts and potential economic benefits (if any).

### Potential mitigation

5.6.8. Construction would be carried out using industry best practice and in accordance with a Construction Environmental Management Plan (CEMP) committed to avoid or reduce any identified and potential impacts. Specific mitigation for the construction of the Proposed Scheme will be reported in the ES. Additional mitigation measures for the historic environment will be reported in the ES and where possible, incorporated within the design.

5.6.9. In addition to the identified cultural heritage mitigation measures, archaeological investigation (evaluation of buried remains) would be undertaken to help understand the value of assets and where there is potential for loss. The geophysical survey will be followed with archaeological trial trenching. Should the requirement of further investigation be identified, the timing of this would be agreed to design and plan the mitigation programme.

- 5.6.10. Any investigation or mitigation will be carried out in order to address the relevant regional research framework objectives and the information will be made publicly available to current and future generations.

## **5.7. Summary**

- 5.7.1. The Proposed Scheme is likely to result in physical impacts on heritage assets dating from the prehistoric to modern periods. Where these can't be avoided through design ('preservation in situ'), a programme of appropriate mitigation through excavation, recording and publishing of results ('preservation by record') will be developed in consultation with appropriate stakeholders.
- 5.7.2. Potential impacts on the setting of two grade I listed churches located within the study area has been identified. However, the design will be developed to reduce setting impacts as far as reasonably possible and will be reported within the ES. The results of the geophysical and trial trenching surveys will be incorporated into the impact assessment in the ES chapter, where available.

## 6. Landscape and visual

### 6.1. Introduction

- 6.1.1. This chapter presents the preliminary findings of the Landscape and Visual Impact Assessment (LVIA). This comprises a review of the existing environment followed by identification of the potential impacts of the Proposed Scheme and the effects upon surrounding landscape and visual receptors. The chapter also summarises relevant consultation and outlines proposed design measures to help mitigate potential landscape and visual effects.

### 6.2. Assumptions and limitations

- 6.2.1. Visual effects have been considered based on a site visit to publicly accessible areas, therefore it has not been possible to validate the potential for views from all receptors. However, site surveys allows a best estimate of those effects.
- 6.2.2. Existing vegetation survey data was not available at the time of this assessment therefore assumptions have been made about the potential extent of vegetation loss associated with the Proposed Scheme.
- 6.2.3. Proposed mitigation is yet to be designed therefore the assessment assumes a worst-case scenario in identifying the potential nature and extent of landscape and visual effects.

### 6.3. Methodology

- 6.3.1. The methodology for assessing landscape and visual impact complies with the requirements set out in DMRB Volume 11 Section 2 Part 5 LA107 Landscape and Visual Effects. This includes reference to the following best practice guidance:
- Guidelines for Landscape and Visual Impact Assessment Third Edition (Landscape Institute & Institute of Environmental Management and Assessment, 2013)
  - An Approach to Landscape Character Assessment (Natural England and Department for Environment, Food and Rural Affairs, 2014)
  - Landscape Character Assessment (Landscape Institute, Technical Information Note 08/15, 2016)
  - Visual Representation of Development Proposals (Landscape Institute, Technical Guidance Note 06/19, 2019)
- 6.3.2. As part of the ES assessment work, further desktop study and walkover surveys (winter 2020 and summer 2020) will be undertaken to review and update the baseline information gathered in previous stages of assessment.

- 6.3.3. The Zone of Theoretical Visibility (ZTV) will be established based upon the area from which the Proposed Scheme will theoretically be visible to a person with a viewer height of 1.6m above ground level. Digital Surface Model (DSM) data will be used to create the ZTV model. The actual extent of potential visibility of the Proposed Scheme will be refined as part of the site survey to identify the influence of existing vegetation and buildings on the extent of views.
- 6.3.4. The assessment will consider the potential effects of the Proposed Scheme on landscape and visual receptors. Landscape receptors comprise landscape character and elements and visual receptors comprise the people with potential to experience views of the Proposed Scheme.
- 6.3.5. The level and significance of effect on landscape and visual receptors will be determined by combining the sensitivity of the receptor with the magnitude of change attributable to the Proposed Scheme in accordance with the methodology.

## **6.4. Baseline**

### **Study area**

- 6.4.1. DMRB Volume 11 Section 2 Part 5 LA107 Landscape and Visual Effects defines the study area for the LVIA as an area from within which there is potential for the Proposed Scheme to influence landscape or views. Based on the limits to visibility presented by the relatively low lying and gently undulating topography and extensive tree cover, an area up to 1km from the Proposed Scheme is considered sufficient to identify all potentially significant landscape and visual effects.

## **Survey and desk-based information**

### *Landscape character and designations*

- 6.4.2. Landscape character is described in published studies at a national and local scale. The following reference sources have been consulted to inform this assessment:
- National Character Area Profile 78 'Central North Norfolk' (Natural England, 2014)
  - National Character Area Profile 84 'Mid Norfolk' (Natural England, 2014)
  - Breckland District Landscape Character Assessment (Breckland District Council, 2007)
  - Landscape Character Assessment Supplementary Planning Document (Broadland District Council, 2013)
  - South Norfolk Landscape Assessment (South Norfolk Council, 2001)

- South Norfolk Landscape Designations Review (South Norfolk Council, 2012)

- 6.4.3. At a national scale the study area coincides with two of Natural England's National Character Areas, which respectively extend to the east and west of Honingham. Both character areas share similar landscape characteristics and features. As such each area associates with the same ancient countryside origins with a long-settled agricultural character. Arable land is enclosed by winding lanes and hedgerows, with pockets of woodland and remnant heath cut through by pastoral river valleys. A patchwork of cultivated land, numerous church spires, distant wooded horizons and extensive skies are defining features of the landscape. There are however some subtle differences between the two character areas, with the eastern extents more gently undulating relative to the broadly flat landscape of the western extents.
- 6.4.4. In terms of local landscape character, the western part of the study area coincides with Breckland District Council's landscape character assessment. The eastern extents of the study area coincide with the coverage of Broadland District and South Norfolk Council landscape assessments.
- 6.4.5. The respective character assessments summarise the mid and eastern part of the study area around Hockering as having a broad and shallow valley topography, with a geometrical field pattern bounded by mixed species hedgerows, and occasional marshlands. Alder dominated woodland occurs in linear bands along the river, screening views across the area. A network of Public Rights of Way (PRoW) provide access through the area, and the towers of churches, such as those in Hockering and East Tuddenham, are distinctive orientational landmarks on the skyline.
- 6.4.6. The mid and north-eastern extents of the study area around North Tuddenham are characterised by an undulating topography and geometric arable fields, typically bounded by clipped hedgerows with occasional trees, and larger areas of woodland. A network of rural lanes interconnects the hamlets and settlements located throughout the area.
- 6.4.7. The area east of Honingham is noted as being isolated from the rest of the district by the River Wensum, with a gently rolling landform that forms an elevated plateau between the valleys of the River Tud and the River Wensum. Land use is characterised by arable and pastoral fields, together with estate plantations and belts of mixed woodland along the Tud valley. Honingham is the main settlement within an area otherwise characterised by dispersed hamlets and farmsteads. The skyline notably includes a line of pylons that crosses the area on a south-east to north-west alignment.

- 6.4.8. The western settled edge of Easton is described as an area of undulating landscape which slopes towards a ridge between the valleys of the River Tud and the River Yare. The area is characterised by arable and pastoral farmland with occasional larger wooded areas. Fields are irregular and bounded by mature tree lined hedgerows. Easton is the main settlement within the area, with other settlement typically comprising isolated properties within an agricultural landscape.
- 6.4.9. Physical features in the immediate vicinity of the Proposed Scheme which contribute to the landscape character of the wider area include agricultural fields enclosed by hedgerows with mature trees, small areas of woodland and waterbodies. The existing A47 highway boundary is partially defined by mature trees, shrubs and hedgerows.
- 6.4.10. There are no landscape designations associated with the study area with potential to be impacted upon by the Proposed Scheme.

#### *Visual amenity*

- 6.4.11. The study area associates with a wide, gently rolling topography with elevations of between 20 and 60m Above Ordnance Datum (AOD) which affords the potential for extensive views. The extent of visibility is however notably influenced by local topography and by the partial enclosure of tree cover within hedgerows and grouped in larger woodland blocks. The existing A47 is a relatively discrete component of existing views, whereby it typically follows the existing topography and benefits from the visual screening afforded by adjacent trees and hedgerows.
- 6.4.12. The potential for views of the Proposed Scheme includes those from residential properties, users of the local PRoW network and users of community facilities including a number of churches.
- 6.4.13. The potential for views from residential properties includes the settlements of Hockering and Honingham and a wider, dispersed pattern of individual properties and small hamlets spread extensively across the study area. Various PRoW footpaths and bridleways coincide with the extent of the study area, with notable concentrations of routes around Hockering and Honingham. Community facilities with potential to experience views of the Proposed Scheme include St Michael's Church in Hockering, Honingham Village Hall and recreation ground, St Andrew's Church in Honingham and St Peter's Church in Easton. Views of the Proposed Scheme will also potentially be experienced by road users of the A47, B1147 and various minor roads within the extent of study area.
- 6.4.14. Table 6.1 lists the main visual receptors with potential to experience views of the Proposed Scheme.



## 6.5. Consultation

- 6.5.1. A Scoping Report was submitted in September 2019. The resulting Scoping Opinion focussed on the future content of the ES, with expectations for further detail to be provided on the study area, viewpoints, mitigation and existing vegetation. In terms of the PEIR, the Scoping Opinion expressed expectation for agreement of viewpoints with the relevant consultation bodies.
- 6.5.2. Viewpoints to illustrate the typical range of views associated with visual receptors have been agreed with the respective Local Planning Authorities and will be included in the ES.
- 6.5.3. The extent of proposed assessment study area has also been discussed and agreed with the respective Local Planning Authorities.

## 6.6. Scheme considerations

### Potential impacts and effects

#### *Construction*

#### *Impacts*

- 6.6.1. The potential impacts during construction which may result in landscape and visual effects are:
- removal of existing vegetation
  - earthworks
  - presence of construction plant, materials, machinery, construction compounds and construction lighting

#### *Landscape effects*

- 6.6.2. The Proposed Scheme would bring about change in landscape character during construction. The combined loss of highway boundary trees, shrubs and hedgerow along the existing A47 corridor, loss of agricultural land (notably south-west and south-east of Hockering and north, east and west of Honingham) and loss of areas of woodland (notably north of Honingham) would disrupt existing land use and result in an increased sense of openness within the landscape.
- 6.6.3. Construction would result in earthworks along the length of the Proposed Scheme, accentuated in the vicinity of proposed grade separated junctions at Wood Lane and Norwich Road where existing ground levels would be subject to extensive remodelling.

## Visual effects

- 6.6.4. Construction impacts associated with change to existing features and construction activity would potentially result in visual effects on; occupiers of residential properties, recreational users of PRoW, users of local community facilities and vehicle travellers.
- 6.6.5. Receptors with potential to experience visual effects during construction are listed in Table 6.1.

Table 6.1: Main visual receptors with potential to experience visual effects

Receptor	Construction	Year 1	Year 15
<b>Residential:</b>			
Residential properties on the southern edge of Hockering	✓	✓	
Dispersed residential properties on Low Road and Mattishall Lane to the west of Hockering	✓	✓	✓
Individual residential properties in and around Lodge Farm to the north of Hockering	✓	✓	
Dispersed residential properties on Rotten Row, Church Lane and Park Lane to the east of Hockering	✓	✓	✓
Individual residential properties in the vicinity of Berry's Bridge to the west of Honingham	✓	✓	
Residential properties on the northern edge of Honingham	✓	✓	
Residential properties on the southern edge of Honingham (south of Mill Lane)	✓	✓	
Residential properties on the eastern edge of Honingham	✓	✓	
Individual residential properties in and around Hall Farm to the north of Honingham	✓	✓	✓
Individual residential properties in and around Church Farm to the east of Honingham	✓	✓	✓
Residential properties on the western edge of Easton	✓	✓	
Individual residential properties in and around Lower Easton	✓	✓	
<b>Public Rights of Way:</b>			
Users of PRoW in the vicinity of Lodge Farm to the north of Hockering	✓	✓	
Users of the PRoW network between Mattishall Lane, Church Lane and Hall Lane to the south of Hockering	✓	✓	✓
Users of a PRoW on Park Lane to the east of Hockering	✓	✓	
Users of PRoW between Church Lane and Berry's Lane to the west of Honingham	✓	✓	
Users of a PRoW between Dereham Road and Wood Lane to the north of Honingham	✓	✓	✓
<b>Recreational and Community Facilities:</b>			
Users of holiday accommodation on Rotten Row to the south-east of Hockering	✓	✓	✓

Receptor	Construction	Year 1	Year 15
Users of St Michael's Church in Hockering	✓	✓	
Users of St Andrew's Church east of Honingham	✓	✓	✓
Users of St Peter's Church in Easton	✓	✓	
Users of Honingham Village Hall and recreation ground on the northern edge of Honingham	✓	✓	
Roads:			
Users of the A47	✓	✓	✓
Users of the network of minor roads to the west of Hockering, including Fox Lane and Low Road	✓	✓	✓
Users of the network of minor roads to the south of Hockering, including Mattishall Lane, Blind Lane and Hall Lane	✓	✓	✓
Users of the network of minor roads to the east of Hockering, including Church Lane and Sandy Lane	✓	✓	✓
Users of the B1535 west of Honingham	✓	✓	✓
Users of Colton Road, Mattishall Road and Norwich Road south of Honingham	✓	✓	
Users of Grange Lane, Blind Lane and Tavernham Road between Honingham and Easton	✓	✓	✓
Users of Church Lane north-west of Easton	✓	✓	✓

## Operation Impacts

6.6.6. The potential impacts during operation which may result in landscape and visual effects are outlined below. The ES will further detail specific potential impacts:

- introduction of dual carriageway, grade separated junctions and link roads and associated moving vehicles
- changes to the existing road network and WCH
- changes to the existing landform (bunds, embankment and cut)
- loss of existing woodland, trees and hedgerows, and new woodland, trees and hedgerows as mitigation
- new built structures at bridge crossings and junctions
- new road furniture, including signs; and
- new lighting

## Landscape effects

6.6.7. At year 1 of operation, there would be effects on landscape character due to the relative prominence of Proposed Scheme infrastructure (including overbridges)

and loss of mature trees and hedgerow landscape elements and the localised loss and fragmentation of agricultural land.

- 6.6.8. By year 15 of operation, the establishment of Proposed Scheme landscape mitigation would contribute to a reduction in the extent and magnitude of landscape effects. There would however remain the potential for localised residual landscape effects as an outcome of the increase in road infrastructure associated with enlarged junctions and overbridges within an otherwise rural, agricultural landscape.

#### *Visual effects*

- 6.6.9. At year 1 of operation there would be potential for visual effects associated with views of the road infrastructure, including overbridges and vehicles from occupiers of residential properties, recreational users of PRow, users of local community facilities and vehicle travellers.
- 6.6.10. Receptors with potential to experience visual effects during year 1 of operation are listed in Table 6.1 above.
- 6.6.11. By year 15 of operation, the establishment of Proposed Scheme landscape mitigation would contribute to a reduction in the extent and magnitude of visual effects. There would however remain the potential for residual visual effects on the receptors listed in Table 6.1 above.
- 6.6.12. There would also be potential for night time visual effects as a result of the influence of vehicle headlights and Proposed Scheme lighting. Night time lighting effects would reduce over time following establishment of the screening afforded by Proposed Scheme mitigation planting.

#### **Potential mitigation**

- 6.6.13. A comprehensive environmental masterplan and subsequent detailed planting design will be produced to ensure a robust landscape mitigation strategy. Potential mitigation measures will seek to reduce impacts during both construction and operation phases. Detail of the mitigation measures will be outlined in the ES, however they will potentially include the following:

#### *Construction*

- sensitive colouring of welfare facilities and temporary office units within site compounds
- materials delivered on an 'as needed' basis to prevent unnecessary stockpiling
- protection of retained vegetation in accordance with BS 5837:2012

## Operation

- advance planting where possible to ensure earlier maturity of planting and a more effective mitigation strategy
- use of screening earthworks and vegetation to limit views of the Proposed Scheme
- use of native species appropriate to the local environment to aid integration with neighbouring landscape
- design of balancing ponds for landscape and ecological enhancement
- smoothly profiled cuttings and embankments to soften earthwork grading with the surrounding landscape

## 6.7. Summary

- 6.7.1. This chapter has summarised the current (preliminary) understanding of the baseline conditions, mitigation and likely anticipated impacts and effects upon landscape character and visual amenity. Effects on local landscape character and visual amenity are likely during both the construction and operational phases as a result of the enlarged junctions and overbridges within the otherwise relatively rural, agricultural landscape. Landscape design will be developed to reduce any significant operational effects.
- 6.7.2. Table 6.2 provides a summary of the potential construction and operational effects of the Proposed Scheme upon the surrounding landscape and visual receptors.

Table 6.2: Summary of potential landscape and visual effects

Potential construction effects	Potential operation effects
<p><b>Landscape:</b> Construction effects on local landscape elements and character associated with disturbance to existing land use, the removal of vegetation, earthworks and the presence of construction activity, plant, lighting, material stock piling and construction compounds.</p>	<p><b>Landscape: Year 1</b> operational effects associated with a reduction in extent of tree and hedgerow cover, loss of agricultural land and prominence of highway infrastructure.</p> <p><b>Landscape: Year 15</b> operational effects associated with the increase in highway infrastructure.</p>
<p><b>Visual:</b> Construction effects associated with change to existing features the removal of vegetation and the presence of construction activity, plant, lighting, material stock piling and construction compounds. Potential effects on; residential properties in Hockering and Honingham and individual properties in the wider area; recreational users of the local PRoW network; users of community facilities at Hockering, Honingham and Easton; and road users of the A47 and local roads within the study area.</p>	<p><b>Visual: Year 1</b> operational effects associated with visibility of the road/highway infrastructure and vehicles. Potential effects on; residential properties in Hockering and Honingham and individual properties in the wider area; recreational users of the local PRoW network; users of community facilities at Hockering, Honingham and Easton; and road users of the A47 and local roads within the study area.</p> <p><b>Visual: Year 15</b> operational effects associated with residual change in views following the establishment of Proposed Scheme mitigation planting. Potential effects on; dispersed residential properties; recreational users</p>

Potential construction effects	Potential operation effects
	<p>of the local PRoW network; and users of the local road network.</p> <p>Potential night time year 1 and year 15 visual effects on residential receptors as a result of the influence of vehicle headlights and Proposed Scheme lighting.</p>

- 6.7.3. Further work will be undertaken to develop design interventions to limit or reduce the potential for adverse effects and promote opportunities to enhance the environment in the study area wherever possible. Design development and potential mitigation will be reported in the ES as well as further detailing of baseline conditions and likely changes during both construction and operation for all identified receptors.

## 7. Biodiversity

### 7.1. Introduction

- 7.1.1. This chapter presents the preliminary findings of the ecological assessment. This comprises a review of the existing environment and identification of the potential impacts of the Proposed Scheme upon surrounding ecological receptors. The chapter also outlines potential design measures to mitigate potential ecological impacts and summarises relevant consultation.

### 7.2. Assumptions and limitations

- 7.2.1. It should be noted that the absence of certain protected or rare species from the Phase 1 habitat survey does not preclude their presence on a site. There is always the risk of protected or rare species being over-looked, either owing to the timing of the survey or the scarcity of the species at the Site.
- 7.2.2. No details of any additional land take, such as for Site compounds or access routes have yet been confirmed. Impacts identified within this chapter are subject to change during design development. This updated assessment would be included within the Environmental Statement (ES).
- 7.2.3. During the 2019 white-clawed crayfish survey, water depth was too great for surveyors to access potential habitats using waders, therefore small sections of the river were not sampled. It is considered unlikely that these animals would only be present in the small area not sampled.
- 7.2.4. The terrestrial invertebrate surveys commenced in July 2019. The lack of a survey during the early part of the season is not considered to be a limitation as in view of the data and species accumulated during the surveys that were completed; early season surveys would be unlikely to alter the evaluation of each survey area's ecological value to invertebrates.
- 7.2.5. Limitations to the 2019 reptile survey included all 10 of the artificial reptile refugia mats going missing in one of the survey areas. The area is a grass road verge adjacent to the footpath of a busy road on the outskirts of Easton village. The mats were replaced but on the next visit were found to have been removed.
- 7.2.6. Access was denied to two reptile survey areas on one occasion in one area and on two occasions in another area. The latter area has since become outside of the proposed site boundary. The former area will be subject to precautionary measures of fingertip searching prior to construction. No reptiles were found on any other survey visit to these two areas.



- 7.2.7. Access was denied to one waterbody during the great crested newt surveys. Other waterbodies which are located between the un-surveyed waterbody and the scheme were surveyed and found not to have great crested newts present. The nearest waterbody that was found to contain great crested newts was over 860m west of the un-surveyed waterbody. It is considered that great crested newts are unlikely to be present in the un-surveyed waterbody, therefore further survey is not deemed to be required.
- 7.2.8. Another waterbody in Easton Estates was too shallow to take an eDNA sample or bottle trap during the great crested newt surveys. Another waterbody in which great crested newts were found present is located approximately 216m nearer to the A47 in a direct line. Mitigation for the nearer waterbody would also capture great crested newts from the shallow waterbody, should they be present.
- 7.2.9. A section of the survey area within the proposed site boundary north of Honingham, situated between the current A47 and the River Tud, was inaccessible and not surveyed for badgers. This area will be included in the pre-construction badger survey.
- 7.2.10. A section of the River Tud was inaccessible to undertake water vole and otter surveys due to cattle being present with their calves which posed health and safety risks. In addition, during this time the river was also in spate, and the survey conditions were suboptimal due to the likelihood that all signs will have been washed away and entrances to burrows flooded. Other sections could not be surveyed due to dense, impenetrable vegetation. Surveys will be undertaken in 2020 to ensure the full watercourse is surveyed.

### 7.3. Methodology

- 7.3.1. The methodology for the biodiversity assessment follows DMRB Volume 11, Section 3, Part 5 LA 108 *Biodiversity* and CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine.

### 7.4. Baseline Study area

- 7.4.1. Due to the variability of species, the distance at which the Proposed Scheme could affect each species can be different. The study areas used for specific ecological surveys differs dependent on the species and survey. The study area used can be found in Table 7.1.

Table 7.1: Study areas for different receptors

Receptor	Study area distances from the proposed site boundary
<b>Desk Study</b>	
International and nationally designated sites (including Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Wetlands of International Importance (Ramsar Sites), National Nature Reserves (NNRs) and Sites of Special Scientific Interest (SSSIs).	2km (unless hydrologically connected) Design Manual for Roads and Bridges, Volume 11, Section 4, Part 1, LA 115 Habitats Regulations Assessment
SACs designated for bats.	30km Design Manual for Roads and Bridges, Volume 11, Section 4, Part 1, LA 115 Habitats Regulations Assessment
Statutory sites designated for birds.	10km CIEEM 2018 Guidelines for Ecological Impact Assessment in the UK and Ireland
Locally designated conservation sites (including Local Nature Reserves (LNRs), Local Wildlife Sites (LWSs) and RSPB reserves).	2km CIEEM 2018 Guidelines for Ecological Impact Assessment in the UK and Ireland
<b>Field Survey</b>	
Phase 1 habitat survey Botanical survey Fungi survey Reptile survey Bat activity survey	100m CIEEM 2018 Guidelines for Ecological Impact Assessment in the UK and Ireland
Habitat Suitability Index (HSI), eDNA and traditional surveys for great crested newts (GCN) <i>Triturus cristatus</i> , Breeding, wintering and migratory birds	500m Oldham <i>et al.</i> , (2001) Bibby <i>et al.</i> , (2000)
Water vole <i>Arvicola amphibius</i> Otter <i>Lutra lutra</i> .	250m Strachan <i>et al.</i> , (2011) and Dean <i>et al.</i> , (2016); Chanin. (2003)
Badger <i>Meles meles</i> Trees and buildings that may support roosting bats.	50m Harris <i>et al.</i> , (1989); Collins, (2016)
Barn owls	1.5km Shawyer, (2012)
Aquatic macroinvertebrates including white-clawed crayfish <i>Austropotamobius pallipes</i> . Terrestrial invertebrates	Peay, (2003) Within and adjacent to proposed site boundary. Professional judgement based on habitat assessment.

## Desk study and field survey information

### Desk study information

- 7.4.2. A desk top baseline assessment using online resources (MAGIC<sup>2</sup>) identified designated sites and pockets of ancient woodland (which are additionally County

<sup>2</sup> Multi-Agency Geographic Information for the Countryside

Wildlife Site ((CWSs) or SSSI) within the study area as defined in the Scoping Report. Some areas of land within the study area may be designated as CWSs in the future due to the diversity of plant species, including some regionally rare specimens. These areas are highlighted within the ecological constraints plan provided in Figure 7.2.

7.4.3. Table 7.2 presents the nationally and locally designated sites as well as ancient woodland within the study area.

Table 7.2: Designated sites and ancient woodland

Designated site name	Designation type	Distance from Proposed Scheme	Value
River Wensum	Special Area of Conservation (SAC) / SSSI	1.6km north-east	International
Hockering Wood	SSSI and Ancient Woodland	0.55km north	National
Rosie Curston's Meadow	SSSI	1.7km south-west	National
Fen West of East Tuddenham	CWS	0.2km south	County
Land adjoining River Tud	CWS	0.16km north	County
Fen Plantation	CWS	0.3km south	County
River Tud (west)	CWS	0.4km east	County
Park Grove	CWS and Ancient Woodland	0.5km north	National
Harman's Grove	CWS and Ancient Woodland	0.4km north	National
Old Covert, Wood Lane	CWS	Adjacent to the northern boundary	County
Hall Hills/ Ringland Covert	CWS	0.1km north	County
Clippings Green Farm	CWS	0.8km south-west	County
Gravel pits, E Tuddenham	CWS	0.6km south	County
Mouse Wood	CWS and Ancient Woodland	0.5km north	National
Holly Woods	CWS and Ancient Woodland	0.9km east	National
Land adjoining Foxburrow Plantation	CWS	0.5km north	County
Ringlands Hills	CWS	1.3km north-east	County
Lord's Hill and Easton Reeds and Blackhill Wood	CWS and Ancient Woodland	1.5km east	National
Old Hall Meadow	CWS	1km south	County
Ringland Pits	CWS	1.6km north-east	County
Yare Valley	CWS	1.8km south-east	County
North Tuddenham Common	CWS	1.7km west	County
Long Dale	CWS	1.6km east	County
Pasture at Easton College	CWS	1.9km south-east	County

- 7.4.4. Natural Environment and Rural Communities (NERC) Act (2006) Section 41 Habitats of Principal Importance present within 2km include; lowland fen habitat, traditional orchard habitat, coastal floodplain grazing marsh habitat, pond habitats, good quality semi-improved neutral grassland habitat, lowland meadows habitat, and lowland mixed deciduous woodland habitat.

#### *Field survey baseline information*

- 7.4.5. An Extended Phase 1 Habitat survey was undertaken by suitably qualified ecologists in May 2016, in order to assess the ecological importance of the site and determine the requirement for Phase 2 Surveys. Subsequent surveys have been undertaken in 2019 to provide updates to the existing information and additional surveys following the Scoping Opinion.

- 7.4.6. Habitats identified during the Extended Phase 1 Habitat survey are:

- arable
- semi-improved neutral grassland
- broadleaved semi-natural woodland
- mixed semi-natural woodland
- marshy grassland
- dense and scattered scrub
- broadleaved plantation woodland
- running water
- standing water
- buildings
- hedgerows including: 'intact hedge – species rich', 'intact hedge – species poor', 'defunct hedge – species rich', 'defunct hedge – species poor', 'hedge with trees – species rich', 'hedge with trees – species poor'
- dry ditches
- unimproved neutral grassland
- amenity grassland
- recently felled woodland
- bare ground
- tall ruderal

- 7.4.7. Table 7.3 summarises the updated field surveys and results, the surveys which have been completed during 2019 since the scoping report or are now programmed to be completed in 2020 are in bold text. A map of the ecological

constraints based on the results to date is provided in Figure 7.2. Confidential badger sett locations are not included in this map.

Table 7.3: Updated surveys and results update

Survey	Dates of surveys	Study area (including areas not surveyed)	Survey Methodologies (methods, frequencies)	Results (if known)
Phase One Habitat Survey / Preliminary Ecological Appraisal	March - July 2016 April - May 2019 update	All accessible land within the footprint of the Proposed Scheme, plus a 50m buffer.	JNCCs Handbook for Phase 1 Habitat Survey - a technique for environmental audit. CIEEMs Guidelines for Preliminary Ecological Appraisal.	Results will be included in the ES chapter. Will include any changes to the 2016 Phase 1 habitat maps and associated descriptions
Invasive species surveys	During all aquatic and terrestrial Phase 1 and Phase 2 surveys in 2019	All accessible land within the footprint of the Proposed Scheme and within the boundaries of the Phase 2 surveys.	All accessed areas of the Proposed Scheme during the 2019 surveys had INNS recorded in Phase 2 reports or in an incidentals log.	Invasive non-native species found during 2019 surveys included: Aquatic – American mink <i>Neovison vison</i> , red-necked terrapin <i>Trachemys scripta elegans</i> (not Schedule 9); signal crayfish <i>pacifastacus leniusculus</i> ; New Zealand mud snail <i>Potamopyrgus antipodarum</i> (not Schedule 9); freshwater shrimp <i>Crangonyx pseudogracilis</i> (not Schedule 9), killer shrimp <i>Dikerogammarus</i> (not Schedule 9) Terrestrial – Japanese knotweed <i>Fallopia japonica</i> , Chinese water deer <i>Hydropotes inermis</i> , muntjac deer <i>Muntiacus reevesi</i> , ring-necked parakeet <i>Psittacula kramera</i> , Canada goose <i>Branta leucopsis</i> , Egyptian goose <i>Alopochen aegyptiacus</i> , Himalayan balsam <i>Impatiens glandulifera</i> ; rhododendron <i>Rhododendron ponticum</i> ; least duckweed <i>Lemn minuta</i> (not Schedule 9); cotoneaster <i>Cotoneaster</i> sp.; parrots feather <i>Myriophyllum aquaticum</i> ; <i>Potamogeton</i> sp.; snowberry (not Schedule 9).
Phase 2 Botanical Surveys - including aquatic plant species	June - July 2017 Summer 2019	River Tud and associated tributaries Woodlands, marshy grasslands/fens and unimproved grasslands	Aquatic National Vegetation Classification Terrestrial habitats assessed using National Vegetation Classification	Results from the 2017 surveys did not observe any unimproved grassland areas. Two areas of marshy grassland and fen and nine woodlands of moderate or high ecological value were observed within the study area. An update Phase 2 botanical survey was undertaken in 2019. The results were: <ul style="list-style-type: none"> <li>Two units of land valued at county level will be directly affected.</li> <li>Two units of district level valued land will be directly affected.</li> <li>Scarce plant sharp-leaved fluellin <i>Kickxia elatine</i>, rare in county martagon lily <i>Lilium martagon</i>, bee orchid <i>Ophrys apifera</i>, Red Data Book common cudweed <i>Filago vulgaris</i>, wild basil <i>Clinopodium vulgare</i>, marjoram <i>Oreganum majorana</i> and</li> </ul>

Survey	Dates of surveys	Study area (including areas not surveyed)	Survey Methodologies (methods, frequencies)	Results (if known)
				pyramidal orchid <i>Anacamptis pyramidalis</i> were found within the study area.
Hedgerow surveys	September 2017 Summer 2019	Targeted areas	Guidance in The Hedgerows Regulations (1997)	Six important hedgerows were observed during the 2017 surveys. An update Phase 2 botanical survey was undertaken in 2019 which identified 14 important hedgerows, ten of which will be bisected. A further hedgerow may qualify on historic value.
Fungi	September - October 2017 Mid-August - October 2020	Targeted areas	Woodlands - The British Mycological Society Guidance (Illiffe, R. 2006).	The 2017 survey identified low value fungi, almost certainly due to extensive nitrogen deposition through diffuse sources such as fertiliser spray drift and poor air quality along the existing A47 (due to long-term vehicle emissions).
Great crested newt (GCN)	March – June 2016 March – June 2017 April – June 2019	Ponds within 500m of the Proposed Scheme	Habitat Suitability Index (HSI); eDNA (15 April - 30 June); population size class surveys (six visits between mid-March and mid-June, with two between mid-April and mid-May). English Nature (2001) Oldham <i>et al.</i> , (2000) Biggs <i>et al.</i> , (2014)	The 2016 surveys identified: 102 HSI ponds and 53 eDNA ponds were observed. GCN were positive in four of these ponds and indeterminate in three. Nine ponds were not accessed. The 2017 surveys identified: eDNA and population size class was surveyed in 16 ponds, GCN were found in small populations in five of the ponds and a medium population was found in one pond. The 2019 surveys identified: 109 HSI ponds and 62 eDNA ponds. Six of these ponds presented a positive result. These six ponds, and four of the previous ponds surveyed in 2017, had population size class surveys undertaken. The results identified that three ponds had a small GCN population.
Fish	2017 September 2019	Targeted areas	Incidentals during other aquatic surveys	During the 2017 surveys within the River Tud the following species were identified: Bullhead <i>Cottus gobio</i> ; and 3-spined stickleback <i>gasterosteus aculeatus</i> . During the 2019 surveys within the River Tuf, the following species were identified: Bullhead; 3-spined stickleback; brown trout <i>Salmo trutta</i> ; and one river lamprey <i>Lampetra fluviatilis</i> ammocoete
White-clawed crayfish	August - September 2017 September 2019	River Tud	Peay (2003)	The 2017 surveys identified one juvenile near River Tud crossing. The 2019 surveys noted the area of the juvenile white-clawed crayfish <i>Austropotamobius pallipes</i> identified in the 2017 surveys has now been lost.



Survey	Dates of surveys	Study area (including areas not surveyed)	Survey Methodologies (methods, frequencies)	Results (if known)
				A large number (60+) of crayfish were translocated from another area in October 2018 to a safe Ark Site and are no longer present. A single white-clawed crayfish was found during the aquatic invertebrate survey of 2019 in the River Tud east of Mattishall Lane.
Aquatic invertebrates	June - October 2017 September 2019	Targeted areas	Drake <i>et al.</i> , (2007)	No habitat for Desmoulin's whorl snail <i>vertigo moulinsiana</i> found in either 2017 or 2019. Common and generalist invertebrates were found in 2017 and 2019. A single white-clawed crayfish was found in 2017 and 2019.
Terrestrial invertebrates	One survey in September 2017 Summer 2019	Suitable habitats within a maximum of 500m from the Proposed Scheme	Drake <i>et al.</i> , (2007)	No protected or notable species found during the 2017 surveys. An update terrestrial invertebrate survey was undertaken in 2019. Three units of land were assessed at district level which would be affected by the Proposed Scheme.
Badgers	March - July 2016 April 2017 April - June 2019	All accessible land within the footprint of the Proposed Scheme plus a 50m buffer	Standard methodology [Harris <i>et al</i> (1989)]. Search for all field signs within the study area. Field signs include setts and other excavations, latrines, prints and paths, hairs, feeding evidence etc.	The 2016 Phase 1 survey identified four main setts (one of which was active), one inactive subsidiary sett, four inactive annex setts, and three outlier setts (one of which was active). A detailed survey carried out in 2017 included the identification of a further six outlier setts (five active), one subsidiary sett, three annex setts, and two main setts (one active, one abandoned). The 2019 survey identified two active main setts located within 100m from the proposed site boundary; three active outlier setts within the proposed site boundary; and two active outlier and two active subsidiary setts located within 100m from the site boundary.
Bat Roost Appraisals Aerial inspections	January - March 2017 May - July 2017 May - July 2019	All accessible land within the footprint of the Proposed Scheme, plus a 50m buffer	All bat surveys have taken place with reference to Collins, J. (ed.) (2016). Bat Surveys for Professional Ecologists: Good Practice Guidelines, 3rd edition, Bat Conservation Trust.	The 2017 winter survey identified nine trees with the bat roosting potential. The 2017 summer survey identified 117 trees (with five bat roots) and ten buildings (with nine roosts) with bat roosting potential. Two further buildings were appraised for bat roosts in 2019.
Bat Emergence/Re-Entry Surveys	June - October 2019	All accessible land within the footprint of	Emergence/re-entry surveys for high habitat suitability/risk took place three times, for moderate	During 2019, emergence surveys were undertaken on 124 trees and four buildings. Of these, all four buildings and 16 trees were

Survey	Dates of surveys	Study area (including areas not surveyed)	Survey Methodologies (methods, frequencies)	Results (if known)
	April - July 2020	the Proposed Scheme, plus a 50m buffer	suitability/risk twice, and for low suitability/risk once	found to contain bat roosts for all commoner species (Common pipistrelle, soprano pipistrelle, brown long-eared bat). Five additional trees have been identified for survey in 2020.
Bat Activity Transect Surveys	July - October 2017 July - October 2019	All accessible land within the footprint of the Proposed Scheme, plus a 100m buffer	Collins, (2016) High suitability for bats. Two transects were undertaken twice a month for seven months between April and October. Three static detectors were used per transect for five consecutive nights per month.	Nine species of bat were identified during the 2017 surveys. These are concentrated along hedgerows and woodland. Results of the 2019 survey will be reported in the ES.
Bat winter surveys	February 2019 December 2019 - February 2020	Eleven trees (2019) Three trees (2019 – 2020)	Collins, (2016) Aerial climbing, static detectors.	During the 2019 surveys, there was no access for one tree and one tree was not in the study area. Two trees could not be climbed for safety reason and no hibernacula was found in other 7 trees. Surveys using the static detector are still to be undertaken on 3 trees that could not be assessed due to access restrictions during the 2019 surveys.
Birds - Breeding	July 2017 April - June 2019 Barn owl - March and June 2020	All accessible land within the footprint of the Proposed Scheme, plus a 500m buffer	Bibby <i>et al</i> (2000) Gilbert <i>et al</i> (1998) Four surveys were undertaken across the breeding season. Birds were recorded by walking, listening and scanning by eye and with binoculars. Birds were considered to be breeding if singing, displaying, carrying nest material, nests or young found, repetitively alarmed adults, disturbance displaying, carrying food or in territorial dispute.	Only one survey was undertaken in 2017, which recorded 44 species. As only one survey was undertaken the results are not considered to be robust. During the 2019 surveys, 79 species were recorded with 41 species confirmed breeding. 12 were identified as probable for breeding and a further 12 for possible breeding.
Birds - wintering	March 2016 and November 2016	All accessible land within the footprint of	Birds were recorded by walking, listening, and scanning by eye and with binoculars.	The 2016 / 2017 surveys identified - six Schedule 1 species: <ul style="list-style-type: none"> <li>12 Birds of Conservation Concern (BoCC) classified as Red or NERC S41 species,</li> </ul>

Survey	Dates of surveys	Study area (including areas not surveyed)	Survey Methodologies (methods, frequencies)	Results (if known)
	January - March 2017 January - February, and November - December 2019	the Proposed Scheme, plus a 500m buffer	All birds were recorded, regardless of the activity/behaviour	<ul style="list-style-type: none"> <li>11 BoCC classified as Amber species,</li> <li>five BoCC classified as Green species (recorded due to notable numbers or identified as part of an assemblage for the Broadland SPA).</li> </ul> <p>The results from the 2019 survey will be reported in the ES.</p>
Autumn passage birds	March 2017 September 2017 September - October 2019	All accessible land within the footprint of the Proposed Scheme, plus a 500m buffer	Bibby <i>et al.</i> , (2000). Gilbert <i>et al</i> (1998).	<p>Only one survey was undertaken in 2017 which recorded 51 species.</p> <p>The results from the 2019 survey will be reported in the ES.</p>
Reptiles	May, September and October 2016 May – June and August - September 2019	All accessible land within the footprint of the Proposed Scheme, plus a 100m buffer	Froglife (1999) Advice Sheet 10 and the Herpetofauna Workers' Manual (1998). Seven surveys to be undertaken in suitable weather. Use of refugia to attract reptiles on site, manual searches of suitable refugia present on site, checks for signs of reptile activity including sloughed skins, burrows, egg laying sites and sustained visual observation of banks and other suitable habitat within the site.	<p>Four species of reptile were recorded within the study area in 2016 including:</p> <ul style="list-style-type: none"> <li>slow worm <i>Anguis fragilis</i>,</li> <li>grass snake <i>Natrix natrix</i>,</li> <li>adder <i>Vipera berus</i> and</li> <li>common lizard <i>Zootoca vivipara</i>.</li> </ul> <p>The 2019 surveys identified that slow worm and grass snake are low in numbers in one area of the scheme.</p>
Water Vole and Otter	April 2017 October 2019 April 2020	All accessible, suitable habitat within the footprint of the Proposed Scheme, plus a 250m buffer	Standard water vole survey methodologies of Strachan <i>et al.</i> (2011) and Dean <i>et al.</i> (2016), searching for field signs including latrine sites, feeding stations, lawns, prints and runways. Standard otter survey methodology as identified in Monitoring the Otter, Chanin (2003).	<p>Otter and water vole field signs were found in 2017.</p> <p>Otter signs were found in 2019 on River Tud and one ditch. Water vole signs were found in 2019 on River Tud.</p>

Survey	Dates of surveys	Study area (including areas not surveyed)	Survey Methodologies (methods, frequencies)	Results (if known)
			Surveys involved searching for spraints, footprints, feeding remains, slides and haul-outs, couches and holts.	

7.4.8. Ecological surveys to be completed in 2020 include:

- fungi
- barn owl
- five trees to have bat emergence surveys
- three trees to have bat hibernacula surveys
- completion of the otter and water vole surveys

## Valuation of ecological receptors

7.4.9. A summary of the valuation of ecological receptors relevant to the Proposed Scheme is provided in Table 7.4. Only receptors valued at local value and above are to be assessed in the ES.

Table 7.4: Valuation of ecological receptors\*

Ecological receptor	Description and location	Value
<b>NERC Act 2006 and UKBAP Priority Habitats within 2km</b>	lowland mixed deciduous woodland, important and species-rich hedgerows, standing water and traditional orchards, lowland fen, coastal floodplain grazing marsh, good quality semi-improved neutral grassland, lowland meadows, rivers, no priority habitat but additional habitats present..	National
<b>Arable</b>	within and adjacent to the proposed site boundary of the Proposed Scheme.	Negligible
<b>Semi-improved Neutral Grassland Norfolk BAP</b>	One parcel within the proposed site boundary of the Proposed Scheme.	County
<b>Marshy Grassland NERC Act 2006 Habitat</b>	within proposed site boundary - coastal floodplain grazing marsh. One area north of the A47 north of the River Tud.	National
<b>Tall Ruderal</b>	within and adjacent to the proposed site boundary of the Proposed Scheme.	Negligible
<b>Hedgerows Norfolk BAP</b>	Species poor within and adjacent to the proposed site boundary of the Proposed Scheme.	County
<b>Broad-leaved Plantation Woodland</b>	within and adjacent to the proposed site boundary of the Proposed Scheme.	Local
<b>Broad-leaved semi-natural Woodland Priority Habitat Inventory</b>	Eight parcels within and adjacent to the proposed site boundary of the Proposed Scheme.	National
<b>Mixed semi-natural woodland NERC Act 2006</b>	within and adjacent to the proposed site boundary of the Proposed Scheme.	National
<b>Dense and scattered scrub</b>	within and adjacent to the proposed site boundary of the Proposed Scheme.	Negligible
<b>Running water NERC ACT 2006</b>	River Tud within and adjacent to the proposed site boundary of the Proposed Scheme.	National
<b>Dry Ditches</b>	within and adjacent to the proposed site boundary of the Proposed Scheme.	Negligible

Ecological receptor	Description and location	Value
<b>Buildings</b>	within and adjacent to the proposed site boundary of the Proposed Scheme.	Negligible
<b>Unimproved neutral grassland</b>	Field to the east of Church Lane and south of the A47	Local
<b>Amenity grassland</b>	within and adjacent to the proposed site boundary of the Proposed Scheme	Negligible
<b>Recently felled woodland</b>	within and adjacent to the proposed site boundary of the Proposed Scheme.	Negligible
<b>Bare ground</b>	within and adjacent to the proposed site boundary of the Proposed Scheme.	Negligible
<b>Terrestrial Invertebrates</b>	within and adjacent to the proposed site boundary of the Proposed Scheme.	Local
<b>Aquatic Invertebrates</b>	within and adjacent to the proposed site boundary of the Proposed Scheme	Negligible
<b>White-clawed Crayfish</b>	Single animal found in River Tud, the Tud population has been rescued and moved to an ark site due to the presence of invasive signal crayfish rendering this population unviable.	Regional
<b>Fish</b>	Bullhead (NERC Act 2006) in River Tud	Local
<b>Desmoulin's Whorl Snail</b>		Negligible
<b>Great Crested Newt</b>	>500m outside the proposed site boundary of the Proposed Scheme	Local
<b>Reptiles</b>	within and adjacent to the proposed site boundary of the Proposed Scheme.	Local
<b>Birds</b>		Local
<b>Barn owl (Norfolk BAP)</b>		County
<b>Bat Roosts (some soprano pipistrelle and brown long-eared bat on Norfolk BAP)</b>	within and adjacent to the proposed site boundary of the Proposed Scheme.	County
<b>Bat Activity (<i>Barbastella barbastellus</i>)</b>		Regional
<b>Badgers</b>	within and adjacent to the proposed site boundary of the Proposed Scheme.	Negligible (although subject to legal constraints)
<b>Fungi</b>	within and adjacent to the proposed site boundary of the Proposed Scheme.	Unsurveyed in 2019.
<b>Otters</b>	within and adjacent to the proposed site boundary of the Proposed Scheme.	Local
<b>Water voles</b>	within and adjacent to the proposed site boundary of the Proposed Scheme.	Local
<b>Invasive species</b>	within and adjacent to the proposed site boundary of the Proposed Scheme	Negligible (although subject to legal constraints)
<b>Notable species (hedgehogs <i>Erinaceus europaeus</i> and</b>	within and adjacent to proposed site boundary of the Proposed Scheme.	Local

Ecological receptor	Description and location	Value
brown hare <i>Lepus europaeus</i> )		

\*SAC, SSSI, CWS and Ancient Woodland is classified in Table 7.4

## 7.5. Consultation

7.5.1. Since the scoping report, consultation has been undertaken with:

- Planning Inspectorate
- Norfolk County Council
- Environment Agency
- Natural England
- Norfolk Wildlife Trust

7.5.2. The key topics from each consultee are summarised below.

### Planning Inspectorate

7.5.3. The Planning Inspectorate made comments upon the receptors that need to be included in the ES and their assessment. All receptors mentioned will be included and assessed in the ES.

### Norfolk County Council

7.5.4. Norfolk County Council considered that the baseline data presented in the scoping report was broadly accurate. They considered the data collected up to the scoping opinion request was appropriate and supported the surveys recommended for 2019.

7.5.5. Norfolk County Council commented on their own bat records held after work on another potential highways scheme. The records will be requested for assessment and reported in the ES.

### Environment Agency

7.5.6. The Environment Agency commented on their own biological records for fish and other fauna. The records will be requested for assessment and reported in the ES.

### Natural England

7.5.7. Natural England strongly recommend that Norfolk County Council are contacted regarding the Norwich Western Link road which will connect this with the A1065. Norfolk County Council also holds records for the Norwich Northern Distributor



Road. Natural England suggested that it may be necessary to undertake further bat surveys.

- 7.5.8. Data will be requested from Norfolk County Council regarding surveys that have been undertaken in 2019 for Norwich Western Link Road and previous records from surveys to support the now completed Norwich Northern Distributor Road. On assessment of this data, further surveys may be required in 2020.
- 7.5.9. Consultation will be undertaken with Natural England to discuss the findings of the Habitats Regulations Assessment report that is to be undertaken in 2020.

### **Norfolk Wildlife Trust**

- 7.5.10. Consultation with the Norfolk County Council ecologist was made in December 2019 regarding proposed ground investigation surveys in a proposed CWS. The ecologist recommended contact with Norfolk Wildlife Trust. Contact was made with Norfolk Wildlife Trust in December 2019, but there has been no reply to date.

## **7.6. Scheme considerations**

- 7.6.1. Measures to guide the design process and distinguish mitigation requirements will be identified. The measures below are not an exhaustive list and a review of additional measures will be undertaken following completion of the survey work to inform the next design iteration. These will be reported in the ES and include:
- Dualling the A47 will widen the road and create further crossing distance for fauna. Consideration will be given to bats and low-flying birds in the landscape design of the scheme by creating high tree lines at crossing points.
  - A badger tunnel and associated fencing may need to be incorporated where the route between a main sett and an outlier sett is dissected by the scheme. This would prevent badgers being killed on the road and causing an accident. The tunnel would likely be used by other mammals such as deer and foxes.
  - Minimising illumination where possible and ensuring that any lighting that is necessary is directed and localised to prevent detrimental effects to habitat quality and function and nocturnal fauna.
  - Sensitive working methods to be implemented during construction works, such as working under protected species mitigation licences for example for bats, water voles and great crested newts. Other species not protected directly, but considered priority species, would require works to be undertaken in accordance with non-licensed mitigation strategies.
  - Considerate design, such as the use of drainage infrastructure that is designed to avoid trapping amphibians, and the design of balancing ponds to minimise risks and encourage wildlife during the operational phase.

## Potential impacts

- 7.6.2. Potential impacts will be detailed further for the ES, however high-level impacts are provided below.

### *Designated sites and priority habitats*

- 7.6.3. No direct impacts are anticipated on any statutory designated sites. A Habitat Regulations Assessment will be undertaken to assess indirect impacts from construction and operation of the scheme upon the River Wensum SAC.
- 7.6.4. The nearest CWS is Hall Hills Ringland Covert CWS approximately 100m north of the proposed site boundary. A proposed CWS is within the proposed site boundary. No direct impacts are anticipated to the existing CWS but direct impacts on the proposed CWS may involve the accommodation of any requirements for compensatory flood storage. Indirect impacts on all CWS from air pollution, noise and water/drainage levels changing may arise without mitigation.
- 7.6.5. Direct impacts on priority habitats that are located within the proposed site boundary may arise. These include:
- Hedgerows to be lost or severed
  - *'Lowland mixed deciduous woodland', 'standing water', 'lowland fen', 'coastal and floodplain grazing marsh', 'good quality semi-improved neutral grassland' and 'no Priority Habitat but additional habitat present'* to be lost either permanently or temporarily for access, compounds and compensatory flood storage
  - Running water – banks of River Tud would be lost or disturbed during bridge construction
- 7.6.6. Indirect impacts from air pollution, noise and water/drainage levels changing upon Priority Habitats close to the proposed site boundary may also arise without mitigation. These Priority Habitats include all of those listed in section 7.7.3 plus lowland meadows.

## Habitats

- 7.6.7. There are habitats within the proposed site boundary that are not priority habitats but still of local or above conservation value and will be impacted by loss or by severance of connecting habitats. These include semi-improved and unimproved neutral grassland, broad-leaved woodland and broad-leaved plantation woodland.

- 7.6.8. The majority of permanent and temporary land take will be from habitats of low conservation value including arable, tall ruderal, dense and scattered scrub, dry ditches, amenity grassland, recently felled woodland and bare ground. No buildings are to be lost, but there may be disturbance during construction.

## Protected and notable species

### Flora

- 7.6.9. The current design would impact on areas containing notable plant species bee-orchid *Ophrys apifera*, pyramidal orchid *Anacamptis pyramidalis*, common cudweed *Filago vulgaris*, wild basil *Clinopodium vulgare*, wild marjoram *Origanum vulgare* and bluebell *Hyacinthoides non-scripta*. These species may be lost within areas impacted by the Proposed Scheme.

### Aquatic invertebrates (white-clawed crayfish)

- 7.6.10. Without mitigation, white-clawed crayfish could be affected by pollutants and sediments entering the water. Changes in water levels would also impact this species.

### Terrestrial invertebrates

- 7.6.11. Habitats that supported a local value terrestrial invertebrate assemblage were semi-improved neutral grasslands, unimproved neutral grasslands, marshy grasslands and broad-leaved deciduous woodland. If the habitats are lost, the invertebrates present there would also be lost.

### Fish

- 7.6.12. Without mitigation, fish could be affected by pollutants and sediments entering the water. Changes in water levels would also impact these species.

### Great crested newts

- 7.6.13. No breeding ponds would be lost to the design. Terrestrial habitat would be lost permanently and temporarily within 500m of the breeding ponds. Great crested newts could be killed or injured during construction.

### Reptiles

- 7.6.14. The area where slow worm and grass snake were recorded will not be directly impacted by the Proposed Scheme. There is a possibility that low numbers of reptiles may move into areas of the scheme that could be impacted by construction and reptiles could be injured or killed.

## *Birds*

- 7.6.15. Breeding, foraging and roosting habitat for the bird assemblage including broad-leaved woodland, hedgerows, grasslands, wetlands and arable land could be lost or fragmented by the Proposed Scheme. Visual (light) and noise disturbance from machinery during the construction phase will likely lead to desertion or avoidance of the wider area by breeding bird species. Noise pollution influences the population densities of breeding birds and deters overwintering birds. During operation of the scheme, mortality rates of birds struck by the faster moving traffic could increase. A lack of tall vegetation alongside the new carriageway and an increase in traffic speed will have an adverse effect on owl species across the site and could potentially lead to the loss of barn owl across the site.

## *Bats*

- 7.6.16. The loss of twelve trees within the scheme boundary would result in the loss of twelve bat roosts. Disturbance to four buildings during construction would result in the disturbance of four roosts. Light and noise pollution will affect bats' foraging and commuting behaviour. Loss of woodlands and severed hedgerows would impact bat activity and flight lines between roosts and foraging areas and reduce the amount of foraging habitat. A lack of tall vegetation alongside the new carriageway at crossing points for bats could increase their mortality as they would cross the road at lower heights and collide with traffic.

## *Badgers*

- 7.6.17. Should works occur within 30m of the four active badger setts found within the proposed site boundary, impacts may include loss of setts and disturbance to badgers. Badgers may become trapped in excavations during construction. The mammal track between a main sett and an outlier would be severed by a proposed side road. Increased mortality when crossing the wider carriageway and new side roads is likely.

## *Otters*

- 7.6.18. Without mitigation, otters are likely to leave the river at the point where construction takes place to cross it and either enter the works area or cross the road where they could be killed and injured. Lighting at night would disturb otters. A potential otter holt may be disturbed by the scheme. Otters will be affected by pollutants and sediments entering the water. Changes in water levels would also impact these species.

### *Water voles*

- 7.6.19. Water voles and their burrows could be killed and destroyed by the works in the area where the road crosses the River Tud and any other works to the river banks within the scheme. Water vole foraging habitat would be lost. Water voles could be affected by pollutants and sediments entering the water. Changes in water levels would also impact this species.

### *Invasive species*

- 7.6.20. Without mitigation, invasive species would be spread by the construction work.

### *Notable species*

- 7.6.21. Brown hare and hedgehogs would be killed or injured and their habitats lost without mitigation. During operation, the wider carriageway would result in higher mortality.

## **Potential mitigation**

- 7.6.22. Potential mitigation measures which may be identified within the ES are outlined below. However, specific mitigation measures will be developed and reported within the ES.

### *Habitats*

- 7.6.23. All habitats lost or severed will be compensated by a landscape re-planting design that will enhance and increase the biodiversity value and area of the habitats lost. Requirements of all of the protected species found will be incorporated into the landscape design.

### *Protected and notable species*

- 7.6.24. Measures to control pollution from light, noise and accidental spillages will be implemented via a CEMP.
- 7.6.25. Measures to maintain current water levels will be implemented during construction via a CEMP.

### *Flora*

- 7.6.26. Notable plants will be moved out of the way of construction into a suitable receptor area if they are to be directly impacted.

### *Terrestrial invertebrates*

- 7.6.27. The loss of terrestrial invertebrates will be compensated for by the habitat creation measures in section 7.8.1.

### *Fish and white-clawed crayfish*

- 7.6.28. Fish rescue may need to be undertaken during works to cross the River Tud. An ecologist with a crayfish licence will be on call should a white-clawed crayfish be discovered in this area. Works will be timed to avoid fish spawning season or crayfish during winter.

### *Great crested newts*

- 7.6.29. To prevent the killing and injury of this species during construction, works will be undertaken under a Natural England European Protected Species great crested newt mitigation licence. A receptor area will be found or created and newts will be captured from the zone of impact and relocated in the receptor area during the newts active season. Fencing will be used to prevent newts from re-entering the works area. Further enhancement of the full scheme design will feature some newt habitat in the form of new breeding ponds and hibernacula. Once works have finished, the fencing will be removed and the newts will be free to disperse.

### *Reptiles*

- 7.6.30. Reptiles are a mobile species and to prevent the injury or death of a reptile that has ventured into the works area during the construction phase, an Ecological Clerk of Works (ECoW) will search the areas to be cleared of vegetation immediately before strimming. Reptiles will be moved to a safe area.

### *Birds*

- 7.6.31. Where any parts of the Proposed Scheme traverse linear habitat feature such as drainage ditches, low-flight prevention screening will be installed to help prevent barn owl road casualties. This would consist of high hedges or tree screens being planted on raised banks (bunds) at locations where barn owls regularly cross roads and where potential or known 'blackspots' have been identified.
- 7.6.32. If it is not possible to retain existing hedgerows, trees and areas of scrub, any vegetation clearance required as part of the scheme would be undertaken outside of the main breeding bird season (September to February inclusive). If this is not achievable, suitable nesting habitat would be checked immediately prior to vegetation removal by an ecologist (no more than 48 hours) in order to confirm no nesting birds are present. Should an active nest be found, an

exclusion area around the nest site would be established and works within that area ceased until all young birds are fledged.

- 7.6.33. Site compounds should be screened off from the surrounding habitat to reduce visual disturbance.
- 7.6.34. Mitigation measures could include the installation of nest boxes on retained trees. This would mitigate for the loss of nesting habitats such as trees, hedgerows and scrub. The requirement for nest boxes would be identified within the ES.

### *Bats*

- 7.6.35. Bat roosts in trees will be retained and protected from disturbance where possible. Roosts in trees to be removed will be soft-felled under a Natural England European Protected Species mitigation licence outside of sensitive seasons for bats (maternity and hibernation). Disturbance to roosts in buildings will be covered by the licence and may include mitigation to avoid noise and vibration at times of the year when bats are roosting. All works will be supervised by an ECoW with a class 2 bat licence.
- 7.6.36. High hedges or tree screens being planted on raised banks (bunds) at locations where bats regularly cross the road are to be planted.
- 7.6.37. Tree and hedgerow planting to replace severed bat commuting routes and to increase foraging areas will be undertaken.
- 7.6.38. Lighting will be directed away from flight lines and angled downwards.

### *Badgers*

- 7.6.39. It may be necessary to apply for a Natural England licence for destruction or disturbance of badger setts depending upon the final design of the works and the proximity to the setts. Badger presence will be monitored prior to works. As stated in section 7.8.1 badger fencing and a tunnel under a new side road may be required.
- 7.6.40. Trenches and excavations should be covered overnight to prevent harm to any badgers that may have ventured into them. If this is not possible, a means of escape, such as a ramp, should be inserted into the trench/excavation overnight.

### *Otters*

- 7.6.41. Where necessary, fencing will be erected to prevent otters entering the works area or being forced to cross roads. The works will not prevent the free



movement of otters along the river. The river will be monitored for the presence of otter holts that may be disturbed by the river crossing.

- 7.6.42. Trenches and excavations should be covered overnight to prevent harm to any otters that may have ventured into them. If this is not possible, a means of escape, such as a ramp, should be inserted into the trench/excavation overnight.

#### *Water voles*

- 7.6.43. Although the survey is to be completed in 2020, it is known that water voles are present where the new road will cross the river. To prevent killing, injury and destruction of water vole burrows, work will be undertaken under a Natural England mitigation licence. Depending upon the length of the works area along the river, the water voles would either be dispersed further along the river or translocated to another site. Habitat suitable for water voles would need to be created or enhanced along the river or a suitable area sourced offsite to act as a receptor site. The licensed work would be undertaken at times of the year before the young are born and outside of the winter.

#### *Invasive species*

- 7.6.44. Prior to the commencement of any works, invasive plant species that may be spread during the works will be located and removed. Each species will have a method statement to ensure safe removal included in the CEMP. Biosecurity measures will be incorporated into the methods of working to prevent the spread of diseases to protected species.

#### *Notable species*

- 7.6.45. To prevent the injury or death of brown hare, hedgehogs, small mammals and common amphibians that venture into the works area during the construction phase, an ECoW will search the areas to be cleared of vegetation immediately before strimming. Animals will be translocated to a safe area.

## **7.7. Summary**

- 7.7.1. This chapter has summarised the current understanding of the baseline conditions, mitigation and likely anticipated impacts upon ecological receptors. The majority of surveys undertaken in 2019 have pinpointed the valuable habitats and species present which are of nature conservation importance and could be impacted by the Proposed Scheme. The remainder of the ecological surveys and Natural England mitigation licences to be drafted would clarify mitigation measures. Further ecological input into the design details and construction methods would aim to safeguard the conservation status of

protected species populations throughout the construction and operational phases.

- 7.7.2. Specific mitigation measures for protected species would be finalised within the Biodiversity Chapter of the ES.
- 7.7.3. The measures in this chapter have been outlined to guide the design process and identify mitigation requirements. However, these measures are not an exhaustive list and are likely to require a review and additions following completion of the survey and design work.

## **8. Geology and soils**

### **8.1. Introduction**

- 8.1.1. This chapter presents the preliminary findings of the geology and soils assessment. This comprises a review of the existing environment and identification of potential impacts of the Proposed Scheme upon surrounding land. The chapter also outlines proposed design measures to help mitigate these potential impacts and relevant consultation.

### **8.2. Assumptions and limitations**

- 8.2.1. The baseline information on the Proposed Scheme has been based on a desk study of currently available information at the time of writing.
- 8.2.2. To the extent that this chapter is based on information supplied by other parties, it has been assumed that this information is complete and correct.
- 8.2.3. A ground investigation (GI) will be undertaken prior to the ES (in Spring 2020) to confirm the ground conditions in the vicinity of the Proposed Scheme and establish whether any contamination is present in near surface soils.
- 8.2.4. With regards to land quality and contaminated land, it should be noted that there are uncertainties and data limitations concerning geochemical makeup and characteristics of soils, surface water and groundwater.

### **8.3. Methodology**

- 8.3.1. The assessment has been undertaken in accordance with the methodology presented in the Design Manual for Roads and Bridges (DMRB), LA 109 Geology and Soils.
- 8.3.2. The environmental assessment provides a framework for assessing and managing the effects associated with geology and soils from the delivery of this project. These include:
- effects on bedrock and superficial geology including sensitive and or valuable features;
  - effects on soil resources and
  - effects from contamination on human health and surface water and groundwater.
- 8.3.3. The assessment reports on the likely nature and scale of geology and soil effects (positive, neutral or negative) during the construction and the operation of the Proposed Scheme.

## **8.4. Baseline**

### **Study area**

- 8.4.1. The study area considers all locations where physical works and ground disturbance would take place and extends to the immediate locality order to identify any past pollution incidents which may have affected soil within the works area.
- 8.4.2. A desk-top review of available geological, soils, historical Ordnance Survey, published records and reports including a preliminary sources study report (PSSR) was undertaken in February 2018.
- 8.4.3. Observations to determine the accuracy of the available desk study information and identification of sites worthy of further investigation has been made using aerial imagery and limited site visits.
- 8.4.4. DMRB guidance does not provide a set definition of the study area for assessing the effects on agriculture and farm viability. Therefore, the study area has been based on professional judgement and includes all farms, farm access routes, important agricultural infrastructure and agricultural land within the site.

### **Survey and desk-based information**

- 8.4.5. A scheme specific geotechnical and geo-environmental ground investigation will be undertaken in Spring 2020 as part of the assessment. This will be reported in the ES.
- 8.4.6. Baseline data for the Proposed Scheme is set out in Table 8.1.

Table 8.1: Baseline Information

Aspect	Details	
Geology	<p><u>Published geology</u></p> <p>Solid Geology – Chalk strata of the White Chalk Subgroup underlies the scheme alignment. This sub-group includes the Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation.</p> <p>The chalk is not indicated to outcrop within or close to the Proposed Scheme.</p> <p>The British Geological Survey (BGS) sheet memoir 161 states the rockhead of the Upper Chalk Formation bedrock is generally planar at an elevation of between 20 and 30m AOD. However, glacial and post-glacial erosion has resulted in steep-sided valleys in the chalk leading to variable sub-drift topography over a short distance. This is present directly below the route.</p> <p>Superficial Deposits – The superficial deposits comprise a succession of alluvium (clay, silt, sand and gravel) and river terrace deposits (sand and gravel) overlying diamicton (glacial till) of the Lowestoft Formation, and sands and gravels of glacial origin (Sheringham Cliffs Formation). Head deposits comprising a blanket of pebbly clay are present along much of the route to a depth of 1.0m. The Lowestoft Formation underlies the full route alignment. The Sheringham Cliffs Formation is indicated to occur only locally (east of Fox &amp; Hall Lane), generally to the north of the existing A47.</p> <p>The alluvium and river terrace deposits are indicated to be present within close proximity to the River Tud and its tributaries.</p> <p>Available published mapping does not indicate any faults which will impact on the scheme.</p> <p><u>Geology &amp; ground conditions from other sources (i.e. historical mapping and BGS borehole records (from PSSR)).</u></p> <p>Made ground is not shown on the published geological maps to be directly below or close to the route alignment. However, many sand and gravel pits, localised 'heaps' and old/overgrown pits are shown on the large-scale geological maps. These are likely to contain backfill material of unknown composition</p> <p>Available information suggests that rockhead may vary from a depth of 30m to circa 4m, shallowing from west to east.</p>	
Aspect	Details	
Sites of Geological Interest & Natural Mineral Extraction	Historic Quarrying	Many disused marl, sand, and gravel pits close to the route alignment are shown on historical Ordnance Survey (OS) maps. A former brick field and associated kiln was previously located close to what is now Fox Lane. Similar features may be present which are not shown on the available historical maps. There are none known of geological interest.
	BGS Recorded Mineral Sites	According to the Envirocheck report there are three recorded BGS mineral sites within the study area. The status for these is 'ceased'. One quarry site (Costessey Quarry) located close to the existing A47 alignment at Easton is listed as currently active. Within the county of Norfolk extraction of the extensive sand and gravel deposits which can be up to 40m thick, is undertaken for aggregate material. There are none identified within the scheme extents.
Hydrogeology	The study area is underlain by a Principal Aquifer (Chalk) which is highly permeable.	

Aspect	Details
	<p>The White Chalk Subgroup has been classified by the BGS aquifer designations as a Principal Aquifer. Principal Aquifers are defined as aquifers that “support water supply and/or river base flow on a strategic scale.” Within the bounds of the proposed site, the aquifer likely provides base flow to the River Tud.</p> <p>The alluvium, Lowestoft Formation sand and gravels and Sheringham Cliffs Formation sand and gravels are classified by the BGS aquifer designations as Secondary ‘A’ aquifers.</p> <p>Secondary ‘A’ aquifers are defined as “permeable layers capable of supporting water supplies at local rather than strategic scale”. These formations are in good hydraulic connectivity with the underlying bedrock aquifer. Base flow to the River Tud may occur from these aquifers.</p> <p>The Lowestoft Formation (glacial till) is classified by the BGS aquifer designations as a Secondary (undifferentiated) aquifer. Secondary (undifferentiated) aquifer designations are assigned where “the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type”. It is considered that this formation may partially confine the underlying aquifer where thick and less permeable zones occur.</p> <p><u>Groundwater Vulnerability</u></p> <p>Groundwater vulnerability varies across the study area. The majority of the route is classified in terms of aquifer vulnerability as “Principal Aquifer Intermediate” and is generally associated with superficial cover of glacial till and alluvium.</p> <p>The eastern section of the proposed route, approximately from Honingham, is classified as “Principal Aquifer High”, and is associated with the higher permeability of the Lowestoft Formation, and the Sheringham Cliffs Formation.</p>
Aspect	Details
	<p>The route option is within a groundwater Nitrate Vulnerable Zone (NVZ) at the route’s eastern extent, and locally around Honingham.</p> <p><u>Water Framework Directive</u></p> <p>Groundwater within the study area is classified under the Broadland Rivers Chalk and Crag groundwater body, which has Poor Chemical and Quantitative status (2016 cycle 2). Objectives are to achieve Good Quantitative status by 2021, and Good Chemical Status by 2027. The waterbody is protected under the Nitrates Directive and is a Drinking Water Protected Area.</p> <p><u>Water Abstraction and Source Protection Zones</u></p> <p>The proposed route crosses a source protection zone (SPZ) 3 (Total Catchment) generally west of Oak Farm, south of Hockering and east of Honingham. This SPZ is associated with major strategic water abstractions at Costessey to the east-northeast of the proposed route. Any groundworks within the SPZ3 have the potential to affect this abstraction.</p> <p>A new SPZ is to be delineated around a new public water supply at East Tuddenham and is likely to extend into the Proposed Scheme area.</p> <p>There are a number of small and medium private licenced groundwater abstractions within the study area. These are for agricultural and industrial purposes. See Chapter 12 Road Drainage and the Water Environment for more information.</p>

Aspect	Details
Hydrology	<p><u>Surface Water Features</u></p> <p>The proposed route crosses the River Tud, a main river and tributary of the River Wensum Site of Special Scientific Interest (SSSI) and two of its tributaries. There are a number of small ponds within the vicinity of the proposed route.</p> <p>Surface water features within the vicinity of the proposed route may be partially groundwater dependent and receive base-flow from underlying aquifers. The route option is entirely within a surface water NVZ.</p> <p><u>Water Framework Directive</u></p> <p>The entire route option is within the Tud surface waterbody, which is designated as heavily modified. The Tud waterbody achieved its 2015 objectives for Good Chemical Potential and Moderate Ecological Potential, has two linked protected areas (Norfolk Valley Fens and the River Wensum), and is protected under the Nitrates Directive.</p> <p><u>Surface Water Abstractions</u></p> <p>There are 17 licenced surface water abstractions within the study area.</p> <p>See Chapter 13 Road Drainage and the Water Environment for more information.</p>
Aspect	Details
Soil Survey	<p>The MAGIC online map viewer provides information for the soil types present along the proposed route. The route is predominantly underlain by soil described as "Slightly acid loamy and clayey soils with impeded drainage". However, from south of Hockering and Honingham, generally in association with the River Tud and its tributaries, the soil is described as "Loamy and clayey soils of coastal flats naturally high groundwater." As the proposed route approaches Easton, the soil is described as "Freely draining slightly acid sandy soils".</p>
Landfill Records	<p>One historical landfill site has been identified located approximately 400m south of the proposed route at a location within 500m south west of Hockering, accessed from Mill Close. The landfill is Mattisall Landfill, operated by Thomson Brothers, with the licence commencing 31 December 1968. The closure date is not provided. The specified accepted waste type is 'inert'.</p>
Current Land Use and Man-Made Features	<p>The existing A47 road infrastructure is the most prominent man-made feature within the proposed route. Most of the route lies within agricultural land.</p> <p>The proposed route follows the existing A47 road for approximately 1km from the start of the alignment to east of Oak Farm, where it deviates into fields. It then crosses the existing A47 at three locations before re-joining the A47 at the roundabout at Easton.</p> <p>The proposed route crosses six minor roads; Low Road, Mattishall Lane, Mill Lane, Church Lane, Wood Lane and Blind Lane. There are likely to be services associated with these roads, however, their exact position is currently unknown.</p> <p>Industrial land use was dominated by local extraction of gravel, clay, marl and sand by quarrying. The scale of this industry meant that many pits have been excavated both along and close to the route. Many of these pits have been infilled as the industry has declined, of which some have flooded, creating ponds.</p> <p>There is still residential and commercial development in North Tuddenham, Honingham, Hockering and Easton. Additional land uses include a sewage treatment works, two grave yards (St. Andrew's Honingham and St. Peter's Easton), a scrap yard (Thomson's), garage / fuel station (Hockering Motor Services), a timber yard and a building material reclamation and plant hire firm (Mooney's).</p>
Route History	<p>It is understood that a road has been in existence on this alignment since Roman times and has had numerous upgrades, notably in the 1970's and 1980's.</p> <p>The available historical OS maps indicate that the off-line route comprised agricultural fields, rough pasture and woodland with several gravel, clay, marl and sand pits. A brick field with kiln and well were present to the south of the route at Field Lane prior to 1883 and had become disused by circa 1906.</p>



Aspect	Details
	<p>Hockering Wood was developed as a former WWII munitions store with purpose-built roads and bomb stores. This is now a SSSI.</p> <p>The UXO Threat and Risk Assessment report by 9 Alpha Associates for the study site has rated the overall risk to the site as 'medium'.</p>
Potential Contamination Risks	<p>No site-specific baseline land quality data has been obtained from the PSSR.</p> <p>Historical mineral working pits are considered as the predominant former land use with a potential to give rise to localised soil and groundwater contamination. Other plausible sources comprise residues of petroleum hydrocarbons and chemicals accidentally released from vehicles although the Envirocheck report records no pollution incidents associated with spillage of vehicle fuel or chemical loads.</p> <p>Localised potential sources comprise the Grave Yards at St. Andrew, Honingham and St. Peter's, Easton, a timber yard, sewage treatment works, and Mooney's plant hire and building material reclamation yard. It is also possible that minor leaks and spillages of fuel at off-site farms and works, where stored in bulk tanks, may have locally impacted soil and groundwater without giving rise to reported pollution incidents.</p> <p>It is noted that the Envirocheck report does not reference any notifications for land which has been formally determined as 'Contaminated Land' by the local authorities.</p> <p>Hockering Motor Services, Mooney's scrap yard, and Mattisall former landfill site are considered to be located remote from the proposed improvements work and, therefore, unlikely to represent a plausible risk.</p> <p>The potential environmental risks above 'low' associated with possible localised extant on-site sources of contamination comprise:</p> <p>Potential risks to road construction and maintenance workers are considered to be moderate/low due to the higher likelihood of workers coming into contact with potential localised contamination sources during in-ground works. However, the adoption of site health and safety measures may reduce this risk further; and</p> <p>Potential risks to groundwater, abstractions and surface water courses are considered to be moderate / low.</p>

## 8.5. Consultation

- 8.5.1. The Planning Inspectorate provided a response to the Scoping Report with the comments from this response being taken forward to design subsequent assessment.

## 8.6. Scheme considerations

### Potential impacts

#### *Construction*

- 8.6.1. The Proposed Scheme would result in impacts on agricultural land and farm businesses during construction, due to potential severance, loss of access and disruption to drainage and irrigation, together with impacts resulting from the reduction in farm size or manageability or income because of temporary land-take or severance. These are considered to be negligible to slight adverse impacts.
- 8.6.2. The location of the new road extends over and within close proximity to potential small areas of infilled land (for example ponds). The infill composition will be determined during GI and may involve reuse of brownfield (and potentially contaminated) land. This would constitute a permanent negligible to slight beneficial impact due to remediation of the land. However, road construction is likely to involve localised excavation and off-site disposal to landfill of such waste materials owing to anticipated poor geotechnical properties. Depending on the amount of waste that may require excavation and disposal, and also in consideration of the corresponding requirement for replacement construction materials, there may be no overall net environmental benefit or negative impact. The volume of waste that may require excavation and disposal is not known at this stage pending the results of the GI.
- 8.6.3. The proposed alignment passes close to a limited number of potential sources of contamination including a timber yard, building material reclamation yard, former mineral workings and graveyards.
- 8.6.4. Characterisation of these sources will be undertaken as part of the future GI.
- 8.6.5. The CEMP will provide mitigation against any extant soil or groundwater contaminants and fines that may be mobilised by construction activities where pollution of River Tud or groundwater could result. Drainage provision and restoration of the ground cover affected by road construction would re-establish baseline conditions in the longer-term.
- 8.6.6. Construction activities could also create dust which would constitute a temporary negligible adverse impact however the CEMP will mitigate against this.

## Operation

- 8.6.7. In general, geology and soils impacts from road schemes primarily tend to be limited to the construction phase. The newly constructed hardstanding cover may lead to increased surface water run-off during operation however a suitably designed drainage design will limit the potential for this. Uncontrolled runoff onto adjacent agricultural land may give rise to erosion of soil, particularly fines, as a negligible to slight adverse impact.
- 8.6.8. Potential contamination may arise from fuel spills associated with use of the new road where built on existing agricultural land. This is considered to be a negligible to slight adverse impact.
- 8.6.9. Maintenance and operation of new assets that may be constructed or in close proximity to potential sources will require task-specific risk assessments to safeguard workforce and asset functionality. This needs to be based on the results of the GI planned for the Proposed Scheme.
- 8.6.10. The Proposed Scheme would result in permanent impacts on agricultural land including soils as a national resource as well as farming businesses because of land-take and the severance and loss of access, disruption to drainage, irrigation and impacts resulting from reductions in farm size or manageability or income because of land-take, severance or loss of buildings. The predicted impact to agriculture as a result of the Proposed Scheme will be assessed and reported within the ES.

## Potential mitigation

- 8.6.11. Mitigation measures required to minimise potential risk to receptors will be included in the design of the Proposed Scheme and the construction works of the Proposed Scheme as required.
- 8.6.12. A reduction in potential impacts to soil resources can be achieved through the design of the Proposed Scheme, such as minimising the footprint or alterations to the layout or design.
- 8.6.13. Environmental enhancement measures may potentially be identified during the design.
- 8.6.14. The findings of the environmental risk assessment would identify the requirement and scope of any necessary remediation works. The remediation strategy should examine feasible and sustainable options to manage, remove or dispose or treat identified contaminated material where it is cost effective and practicable to do so.

- 8.6.15. The identified strategy will also include measures for managing any previously unknown contamination identified during the works.
- 8.6.16. Impacts during construction can be managed through a CEMP, please refer to Chapter 9: Materials Assets and Waste.

## **8.7. Summary**

- 8.7.1. The scope of the construction works, and the potential significance of direct effects warrant further assessment for the Proposed Scheme. This would include detailed investigation in order to examine the localised identified areas of potential land contamination. The investigation will identify the contaminants present and confirm ground conditions. A remediation strategy will then be developed to consider the appropriate methods of treatment if necessary.
- 8.7.2. The chapter has summarised the current understanding of the baseline conditions, mitigation and likely anticipated impacts upon geology and soils. It will be developed (and reported in the ES) as the design progresses.
- 8.7.3. There is the potential for adverse impacts during construction due to the anticipated use of materials typical for a road infrastructure scheme of this size.
- 8.7.4. Further work will be undertaken to develop design interventions to limit or reduce adverse impacts and promote opportunities for the environment within the study area wherever possible.
- 8.7.5. The design of future investigation works will include consideration of responses from consultees.
- 8.7.6. Any design development and potential mitigation would be reported in the ES as well as further detailing of baseline conditions and material volumes.

## 9. Material assets and waste

### 9.1. Introduction

- 9.1.1. This chapter presents the preliminary findings of the materials impact assessment. This comprises a review of the existing environment and identification of the potential impacts of the Proposed Scheme from the use material assets and the generation of waste.
- 9.1.2. The chapter also outlines proposed design measures to help mitigate potential impacts and relevant consultation that will be undertaken.

### 9.2. Assumptions and limitations

- 9.2.1. Detailed information (including ground investigation data) or estimates on the quantity (and use) of material assets and generation of waste arisings<sup>3</sup> are not currently available for the Proposed Scheme. These shall be developed as the design is progressed<sup>4</sup>; and incorporated into the assessments within the Environmental Statement (ES).
- 9.2.2. The assessment will focus on the construction phase and the associated material assets and waste disposal requirements for the Proposed Scheme's permanent development. The assessment of materials and waste during the operational phase has been scoped out of the ES as it is unlikely for significant effects to arise from the use of material assets or generation of waste during the operation of the Proposed Scheme.

### 9.3. Methodology

- 9.3.1. The assessment<sup>5</sup> for material assets and waste will be undertaken in accordance with recently updated guidance in Volume 11 of the DMRB LA 110: Material assets and waste (DMRB Volume 11, Section 3, Part 13) and reported within the ES.
- 9.3.2. The approach will take account of information including:
- volumes and nature of material assets likely used for construction including acceptable fill material predicted to arise from construction earthworks
  - estimates for waste generation during site remediation, preparation and construction

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<sup>3</sup> Estimates on the volumes of inert, non-hazardous and hazardous waste from earthwork activities are to be based on ground investigation results and the anticipated ratio of made ground and natural soils to be excavated.

<sup>4</sup> When made available, these volumes may also change at the detailed design stage.

<sup>5</sup> Undertaken by a materials/waste specialist working closely with the engineering design team and geotechnical team.

- estimated local and regional waste management facilities and their capacity in the vicinity of the Proposed Scheme
- locations (where present) of mineral sites or peat resources

9.3.3. The assessment of effects on material assets and waste to be undertaken in the ES shall adopt the significance criteria within DMRB LA 110, including:

- source (primary or secondary) of aggregate materials required for the construction of the Proposed Scheme and the associated impact on regional targets for the re-used or recycled content of construction materials
- the type of waste likely to be generated (e.g. inert, non-hazardous or hazardous) and the potential for its treatment and/or re-use in-situ taking account of implementation of the waste hierarchy
- the impact of off-site removal of surplus materials and waste on the capacity and availability of suitable facilities to manage, recycle, treat or dispose of materials and waste generated
- sterilisation (substantially constrain or prevent existing and potential future use of) mineral sites<sup>6</sup> or peat resources

## 9.4. Baseline

### Study area

9.4.1. Under DMRB Volume 11, Section 3, Part 13, LA 110 two geographically different study areas are defined:

- Based on the construction footprint/project boundary (including compounds and temporary land take).
- Based on professional judgement to define this study area on a project by project basis. This should be sufficient to identify:
  - suitable waste infrastructure that could accept arisings and or waste generated by the project; and
  - As the design is progressed, a suitable study area will be defined for the ES including a balance of the proximity principle and value for money.

## Surveys and desk-based information

### *Existing and baseline knowledge*

9.4.2. There are no current estimates on the use of material assets and waste generation during development of the Proposed Scheme. These shall be developed as the design is progressed.

9.4.3. Information on land uses (current and former) and potential sources of land contamination is addressed in Chapter 8: Geology & Soils. These land uses and

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<sup>6</sup> In accordance with Policy CS.16 of the Norfolk Minerals and Waste Core Strategy.

potential contamination sources may require management, treatment and disposal during construction.

- 9.4.4. Where construction waste from the Proposed Scheme cannot be re-used on or off-site, this may result in direct impacts on capacities of the appropriate regional landfills and, where necessary, capacities of landfills outside of the region.
- 9.4.5. The impacts on landfill capacities are an important consideration in the assessment and will be considered in the ES. Identified licenced waste management facilities in the study area are listed in Table 9.1.
- 9.4.6. Commercial construction and demolition (C&D) waste is identified as the most significant source of inert waste in Norfolk and there is the need for additional inert waste recycling infrastructure within the region.
- 9.4.7. The impact of the Proposed Scheme on regional targets for the re-used or recycled content of construction materials will be considered within the ES. This target is 31% for the East of England as derived from DMRB Volume 11, Section 3, Part 13 LA 110.
- 9.4.8. In the county of Norfolk, extraction of the extensive sand and gravel deposits is undertaken to obtain aggregate material assets. Within the proposed site boundary however, there are only small isolated areas of these safeguarded mineral deposits (sand and gravels). The ES shall formally identify mineral safeguarding sites (where present) and assess impacts from the Proposed Scheme on these sites and the potential for sterilisation.
- 9.4.9. Sporadic pockets of peat were recorded at Honingham in the vicinity of the River Tud, as outlined in the Scoping Report. The potential impact on peat resources from the Proposed Scheme will be assessed in the ES.

Table 9.1: Licenced waste management facilities<sup>7</sup>

Site Name	Site Address	Type of Waste Accepted	Approximate distance from the Proposed Scheme
Easton Inert Landfill	Dereham Road, Costessey, NR9 5EQ	A05: Landfill taking non-biodegradable (inert) wastes	0.8km
Postwick Waste Site	Griffin Lane, Saint Andrew, Norwich, NR7 0SL	A06: Landfill taking wastes other than hazardous, non-hazardous and inert wastes	15km

<sup>7</sup> Environment Agency Permitted Waste Sites- Authorised Landfill Site Boundaries (updated December 2019)



Site Name	Site Address	Type of Waste Accepted	Approximate distance from the Proposed Scheme
Attlebridge Landfill	Reepham Road, Attlebridge, NR9 5TD	A06: Landfill taking wastes other than hazardous, non-hazardous and inert wastes	5km
Spixworth Quarry	Buxton Road, Spixworth, NR10 3PR	Inert waste	10.3km
Lyng Sand & Gravel Pit	Easthaugh Road, Lyng, NR9 5LN	A05: Landfill taking Non-Biodegradable Wastes (Non-hazardous)	4.19km

## 9.5. Consultation

- 9.5.1. No specific consultation has been undertaken to date regarding material assets and waste.
- 9.5.2. Relevant bodies shall be consulted to obtain up to date material assets and waste baseline information to inform the assessment within the ES.

## 9.6. Scheme considerations

- 9.6.1. The principles of value engineering have been adopted by the Design Team to optimise the alignment where appropriate. This would directly decrease impacts from the use of materials. Further opportunities to decrease the impacts may also be achieved at the detailed design stage and will be reported in the ES.

## Potential impacts

- 9.6.2. There is the potential for significant adverse impacts during construction due to the anticipated use of materials and generation of waste typical for a road infrastructure scheme of this size. Use of material assets and the production of waste streams which have the potential to generate significant environmental effects are summarised in Table 9.2. The full details of potential impacts as a result of the Proposed Scheme will be identified and outlined in the ES.

Table 9.2: Summary of material assets and waste that have the potential to generate environmental impacts

	Potential material assets use	Potential waste arisings
Site remediation / preparatory / earthworks	<ul style="list-style-type: none"> <li>Requirement to import bulk materials (limited capacity to reuse site material assets) for earthwork</li> <li>Requirements to excavate within mineral safeguarding areas or peat resources</li> </ul>	<ul style="list-style-type: none"> <li>Surplus / unsuitable surface soils (e.g. topsoil), made ground and natural soils (including peat) arising from earthworks</li> <li>Invasive plant species (e.g. Japanese knotweed) and injurious weeds</li> <li>Hazardous or contaminated soils encountered on-site</li> </ul>

		<ul style="list-style-type: none"> <li>Vegetation and other above ground materials produced by site clearance (e.g. litter, fly tipped waste)</li> </ul>
<b>Demolition</b>	<ul style="list-style-type: none"> <li>n/a</li> </ul>	<ul style="list-style-type: none"> <li>Demolition waste from removal of structures, footways and culvert modifications</li> </ul>
<b>Construction</b>	<ul style="list-style-type: none"> <li>Importation of primary aggregates (limited opportunity to re-use site won or import recycled aggregates)</li> </ul>	<ul style="list-style-type: none"> <li>Surplus / unsuitable construction aggregates</li> </ul>

## Potential mitigation

- 9.6.3. Specific quantities of material assets and waste are not available at the time of reporting and would be reported in the ES. Potential opportunities to re-use surplus material within other sections of the A47 will be identified during scheme design (or any other local projects concurrent to the construction phase) would mitigate the impacts from the use of material assets and the generation of waste arisings. Any opportunities will be identified within the ES.
- 9.6.4. In accordance with the waste hierarchy, consideration would also be given to the re-use of waste generated on-site before waste is transported off-site for re-use or disposal.
- 9.6.5. A combination of the SWMP (Site Waste Management Plan) (including a Materials Management Plan, MMP) and the CEMP would ensure that adverse impacts associated with material assets use, waste generation and required transport are managed.
- 9.6.6. Mitigation measures in the SWMP and CEMP may include (but not be limited to):
- implementation of the waste hierarchy and avoiding generation of waste through design
  - use of site-won or recycled material assets as opposed to sourcing new materials
  - where surplus material assets cannot be re-used on-site, seek opportunities for re-use off-site, including other A47 schemes or other projects off-site (for example a quarry restoration scheme)
  - use of material logistics planning to manage procurement, storage and use of material assets and minimise damage, over ordering and wastage
  - encourage local and responsible resourcing of material assets (for example through adoption of BES 6001) and efficiencies by minimal ordering of materials
  - waste to be appropriately segregated and stored or stockpiled on-site by waste type, to ensure waste remains in a suitable condition to be re-used
  - where waste must be taken to a recycling or disposal site, ensure these sites hold the appropriate permits

## **9.7. Summary**

- 9.7.1. The chapter has summarised the current understanding of the baseline conditions, mitigation and likely anticipated impacts upon material asset use and waste. It will be developed (and reported in the ES) as the design progresses.
- 9.7.2. There is the potential for adverse impacts during construction due to the anticipated use of materials and generation of waste typical for a road infrastructure scheme of this size.
- 9.7.3. Further work will be undertaken to develop design interventions to limit or reduce adverse impacts for the environment wherever possible.
- 9.7.4. Any design development and potential mitigation would be reported in the ES as well as further detailing of baseline conditions and material volumes.

## 10. Noise and Vibration

### 10.1. Introduction

- 10.1.1. This chapter presents the preliminary findings of the noise and vibration assessment. This comprises a review of the existing environment and identification of the potential impacts of the Proposed Scheme in the context of noise and vibration. Consultation is identified where relevant to the content and focus of the chapter. The chapter also outlines proposed design measures to help mitigate potential noise and vibration impacts.

### 10.2. Assumptions and limitations

- 10.2.1. This chapter is based on a desk-top study and is qualitative but is informed by the Defra Noise map which is a product of the strategic noise mapping exercise undertaken by Defra in 2017 to meet the requirements of the Environmental Noise Directive (Directive 2002/49/EC) and the Environmental Noise (England) Regulations 2018 (as amended). The quantitative assessment will be undertaken for the ES.
- 10.2.2. The potential impacts and effects of the Proposed Scheme have been undertaken in the absence of the following information:
- construction traffic movements
  - forecast traffic flows
  - forecast traffic speeds
  - percentage heavy goods
  - construction compound locations

### 10.3. Methodology

#### Determining significance

- 10.3.1. The lowest observable adverse effect level (LOAEL) and significant observable adverse effect level (SOAEL) are defined in LA 111. For construction noise, LOAEL should be determined with reference to baseline noise levels and SOAEL should be set at the threshold level determined in accordance with BS 5228-1:2009+A1:2014. For construction vibration, LOAEL is given as 0.3mm/s peak particle velocity (PPV) and for SOAEL, 1.0mm/s PPV.
- 10.3.2. The table below presents the operational noise LOAELs and SOAELs for all receptors:

Table 10.1: Operational noise LOAELs and SOAELs

Time period	LOAEL	SOAEL
Day (06:00 – 00:00)	55dB LA10,18hr façade	68dB LA10,18hr façade
Night (00:00 – 06:00)	40dB L <sub>night,outside</sub> (free-field)	55dB L <sub>night,outside</sub> (free-field)

## Construction

- 10.3.3. When sufficient details on the proposed construction works are made available, a quantitative assessment of construction noise impacts will be undertaken. The construction assessment will be carried out in accordance with the methodology in BS 5228: 2009+A1: 2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites (Ref. 11-14).
- 10.3.4. BS 5228 contains a number of example methodologies for identifying significant construction noise effects based on fixed thresholds or noise level changes. For the purposes of this assessment the 'ABC' method will be adopted. This will be clarified in consultation with the environmental health departments of the relevant local authorities in the area.

Table 10.2: Example threshold of potential significant effect at dwellings

Assessment category and threshold value period	Threshold value, in decibels (dB) (L <sub>Aeq,T</sub> )		
	Category A	Category B	Category C
Night-time (23:00 – 07:00)	45	50	55
Evenings and weekends (19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays)	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75

- 10.3.5. Category A threshold values are to be used when ambient noise levels (when round to the nearest for 5dB) are less than these values. The same holds true for Category B and C.

## Operation

- 10.3.6. The assessment of the operational noise of the scheme will be carried out in accordance with DMRB LA 111 Noise and vibration.
- 10.3.7. LOAELs and SOAELs will be set for all noise sensitive receptors within the study area. Sensitive receptors include dwellings, schools, nursing homes and churches.
- 10.3.8. Noise change due to the project will be determined at noise sensitive receptors within the study area for the following scenarios:
- Short-term: Do-Minimum Opening Year scenario (DMOY) compared against the Do-Something Opening Year scenario (DSOY);

- Long-term: DMOY compared against the Do-Something Future Year scenario (DSFY);
- Non-project noise change: do-minimum future year scenario (DMFY) compared against the DMOY.

10.3.9. The final assessment will determine the likely significant effects on noise sensitive receptors based on the magnitude of change and local circumstances as per guidance within DMRB Volume 1, Section 3, Part 7, LA 111 Noise and Vibration. A full list of the other relevant guidance considered within the assessment will be presented in the ES.

## 10.4. Baseline

### Study area

10.4.1. Under DMRB LA 111 - Noise and Vibration, the study area for assessing and reporting the effects of noise and vibration due to all phases of highways projects is outlined in the table below:

Table 10.3: Indicative study area for each phase and activity

Activity / phase	Study area
Construction noise	300m from closest construction activity
Construction traffic noise	50m from the kerb line of roads with the potential to increase in baseline noise levels of 1dB(A) or more as a result of the addition of construction traffic to existing noise levels
Diversion traffic noise	25m from the kerb line of diversion routes where a project requires full carriageway closures at night (23:00 - 07:00)
Construction vibration	100m from closest construction activity with the potential to generate vibration
Operational noise	600m from new road links or roads physically changed or bypassed by the project

10.4.2. It is noted that each study area above should include:

- all sensitive receptors that are potentially affected by noise and/or vibration
- areas where there is a reasonable stakeholder expectation that a noise and/or vibration assessment is undertaken

10.4.3. For the operational noise assessment, areas within 50m of other road links with potential to experience a short-term basic noise level change of more than 1dB(A) as a result of the Proposed Scheme should also be included. Consequently, the spatial extents of the assessment may extend beyond the physical works associated with the Proposed Scheme.

### *Desk-based information*

#### *Noise-sensitive receptors*

10.4.4. The study area(s) are predominantly rural, with sensitive receptors principally concentrated in the villages of Hockering, Honingham and Easton.

10.4.5. Over 800 noise sensitive receptors have been identified within 600m of the Proposed Scheme. Noise sensitive receptors include:

- Dwellings
- Schools
- Care homes
- Churches
- Other community facilities

10.4.6. Two specialist schools and a care home in Honingham have been identified as being particularly sensitive to noise.

10.4.7. Specific sensitive receptors have also been identified such as a Grade I listed parish church at Easton, Grade II listed house to the west of Church Farm Honingham and two graveyards.

10.4.8. Noise Important Areas (NIA) which are those areas most exposed to noise, have been identified in Noise Action Plans and published by Defra (2017). There are four such NIA within the study area (see Table 10.4) and it is particularly important to avoid increasing noise in these areas.

Table 10.4: Identity of NIAs

ID	Location
5200	Hockering
5201	Hill House Farm
6287	Church House Farm
5202	Easton

10.4.9. Additionally, the Site of Special Scientific Interest (SSSI) Hockering Wood is within the operational noise study area approximately 450m north of the A47.

## Surveys

10.4.10. A baseline noise survey of the Proposed Scheme will be undertaken in February to March 2020. The environmental health department of the relevant local authorities will be consulted prior to undertaking the surveys. Surveys will comprise both long-term and short-term monitoring in accordance with the Calculation of Road Traffic Noise (CRTN) methodology (HMSO, 1988).

## 10.5. Consultation

10.5.1. Consultation has been undertaken in response to comments received in the scoping opinion from the Planning Inspectorate and other consultees. The points raised in the scoping opinion will be addressed in the ES.



- 10.5.2. The scope and methodology are to be discussed with the local authority as the Proposed Scheme progresses and any requirements in a CEMP and Section 61 Certificate (Control of Pollution Act, 1974).

## 10.6. Scheme considerations

### Potential impacts

#### *Construction*

- 10.6.1. During construction, the Proposed Scheme has the potential to directly alter the noise and vibration baseline for sensitive receptors. Impacts are likely to be restricted to receptors located in the vicinity of the Proposed Scheme, and receptors located adjacent to the road network used for construction related traffic.
- 10.6.2. Mitigation measures such as the shielding of noisy items of plant, the use of enclosures and the use of appropriate screening will be included within the CEMP. Construction noise would be managed to appropriate levels and is therefore not anticipated to have significant direct effects. However, at this stage with insufficient information on construction activities further assessment will be needed to confirm this and to inform the mitigation strategy. This will be undertaken based upon the requirements of BS 5228 Parts 1 and 2 during the EIA process.

#### *Operation*

- 10.6.3. During operation, there is the potential for changes to traffic flows and road alignment to result in noise changes at noise sensitive receptors, including NIAs. It is anticipated that a number of dwellings may experience a noise increase. Including, but not limited to, the following;
- Dwellings on Low Road
  - Dwellings on Mattishall Lane
  - Dwellings on Mill Lane
  - Dwellings in the village of East Tuddenham
  - Dwellings on Church Lane
  - Other isolated properties
- 10.6.4. Further details on the extent of noise increases on noise sensitive receptors will be reported in the ES alongside the appropriate mitigation measures.

## Potential mitigation

- 10.6.5. Potential noise impacts during construction would be mitigated through measures included within the CEMP, which would be prepared alongside the ES.
- 10.6.6. The appropriate mitigation will be implemented where required following the assessment on noise which will be reported in the ES.. Nonetheless, it is considered that there is the potential for significant residual adverse effects to noise sensitive receptors which warrants detailed assessment.

## 10.7. Summary

- 10.7.1. This chapter has identified potential noise and vibration impacts of the Proposed Scheme, both short-term impacts associated with construction activities and long-term impacts due to road traffic noise.
- 10.7.2. Sensitive receptors in proximity to the Proposed Development have been identified. It has been demonstrated that receptors close to the A47 are currently exposed to relatively high noise levels due to road traffic. It is anticipated that the realignment of the A47 at the villages of Honingham and Hockering could result in a noise benefit for the majority of dwellings. However, the same realignment could lead to higher noise levels at a smaller number of noise sensitive receptors situated closer to the new alignment. The results of which will be identified in the ES following noise modelling.
- 10.7.3. Noise impacts due to the construction of the Proposed Scheme are likely to occur at nearby sensitive receptors; particularly at frontline properties along the A47 and would be controlled by a CEMP.
- 10.7.4. Any changes in road traffic noise due to the introduction of new slip roads, changes in alignment, changes in traffic mix and speed, road surface and any barriers or bunds would be calculated and assessed in detail for the ES; and design interventions would be incorporated to avoid or reduce impacts where possible.

## 11. Population and human health

### 11.1. Introduction

- 11.1.1. This chapter sets out the baseline and assesses the preliminary impacts on the local population and human health arising from the Proposed Scheme.

### 11.2. Assumptions and limitations

- 11.2.1. The assessment relies on desk-based information, using publicly available information where available. The information includes strategic documents, Geographical Information System (GIS) software and the 2017 Environmental Assessment Report for the Proposed Scheme.
- 11.2.2. No walking, cycling and horse-riding (WCH) surveys have been undertaken at this stage.
- 11.2.3. The requirement to assess health as part of road projects came into force in October 2019. The Scoping Report was published prior to this and therefore does not contain specific reference to human health.
- 11.2.4. Consultation with stakeholders to inform the health assessment has not yet been undertaken. This PEIR therefore relies on publicly available online health information. Stakeholder consultation will be undertaken in 2020 and information gathered will be used to inform the health assessment.

### 11.3. Methodology

- 11.3.1. Design Manual for Roads and Bridges (Volume 11, Section 3, Part 6) LA 112 Population and human health sets out the requirements for assessing and reporting the environmental effects on population and health from construction, operation and maintenance of highway projects and has been used for the assessments within this chapter.

#### Health

- 11.3.2. Currently, there is no definitive UK guidance on health assessments, therefore a combination of guidance has been used, as follows:
- DMRB LA 112 Population and Human Health (2019)
  - Health in EIA – A Primer (IEMA, 2017)
  - Health Impact Assessment Tools (Department of Health, 2010)
- 11.3.3. Additional guidance may be used as the assessment progresses, and any newly published guidance will be reviewed and used if relevant.

- 11.3.4. This report provides the initial outputs of the scoping stage of the health assessment as well as the potential for positive and/or negatives health outcomes. A systematic approach will be undertaken to assess the health effects of the Proposed Scheme, following Figure 3.36 in DMRB LA 112.
- 11.3.5. A qualitative approach will be undertaken as it is not possible to quantify the severity or extent of the effects which would give rise to health outcomes. This approach will use a source-pathway-receptor model, as advised by IEMA.
- 11.3.6. The health profile of local communities has been established using Public Health England Local Authority Health Profiles (available online). The purpose of health profiling is to identify relevant community groups who may be affected by the Proposed Scheme and to establish the sensitivity of the communities.
- 11.3.7. Health determinants have been identified using the following categories: healthcare facilities; community, recreational and education facilities; green/open space; air quality; noise; and road safety. From the desk-based information gathered to date, these are considered to be most relevant to the Proposed Scheme.
- 11.3.8. Information from other environmental factors, such as air quality, noise and landscape will be used to inform the health assessment.

## **11.4. Baseline**

### **Study area**

- 11.4.1. The study area for the land use and accessibility assessment is based on a 500m area surrounding the proposed site boundary (including the construction footprint). Where likely significant effects are out-with this boundary, the study area will be extended accordingly using professional judgement and the most up to date available guidance. The study area is shown in Figure 11.1.
- 11.4.2. The human health study area shall be defined based on the extent and characteristics of the Proposed Scheme and the communities/wards directly and indirectly affected by the Proposed Scheme.

## **Surveys and desk-based information**

### *Private property and housing*

- 11.4.3. There are a large number of residential properties located in the study area. These are primarily located in Hockering, Honingham and Easton. Smaller clusters of residential properties are also located on Hall Lane, Mattishall Lane, Church Lane and Taverham Road.

- 11.4.4. The Proposed Scheme is not predicted to result in the demolition of private properties.

#### *Community land and assets*

- 11.4.5. Community land and facilities located in the study area of the Scheme are located in the villages Hockering, Honingham and Easton.
- 11.4.6. In Hockering, community facilities include St Michael's Church, Hockering playing field, Hockering Church of England Primary Academy, Hockering Village Hall, Victoria Inn public house, Hockering Nursery and Hockering Post Office and shop.
- 11.4.7. In Honingham there is a Village Hall, children's play area, Honingham Buck public house and St Paul's Chapel of Ease. Further east of Honingham itself and north of the A47 is Saint Andrew's Church, Honingham. West of Honingham, and just outside the LIA (265m south of the current A47) is Merrywood House Residential Care for children.
- 11.4.8. In Easton, community facilities include Saint Peter's Church, Allotment gardens, the village hall and Easton Post Office.
- 11.4.9. The nearest GP surgery to Hockering and Honingham is approximately 2 miles south of Hockering and approximately 3 miles west of Honingham (Mattishall Surgery, Dereham Road). The nearest GP surgery to Easton is approximately 2 miles east (Roundwell Medical Centre, Norwich). There are a number of GP surgeries in Norwich.
- 11.4.10. The frequency of use of areas of community land will be determined in the ES.

#### *Development land and businesses*

- 11.4.11. There are a large number of businesses located in the study area. The majority of the businesses are located in the villages of Hockering, Honingham and Easton, with a small number of businesses in more isolated locations along the route.
- 11.4.12. In Hockering, businesses include Hockering Motor Services, Kerrie Woollen Cakes and Claxtons Home Improvements. Just south east of Hockering (and south of the A47) is also Mooney Demolition, Reclaimed Building Materials and Plant Hire.
- 11.4.13. Business located in Honingham include Hulbert West financial advisors, H Smith and Sons Construction Company, the Honingham Buck restaurant and LS Sewing Services.

- 11.4.14. Easton is the largest village with the most facilities. However, as it is located at the most easterly point of the scheme and not all businesses fall within the study area. Business that do, however, include Easton Guesthouse, The Salon hairdressers and Adams Automotive Engineering.
- 11.4.15. Businesses located outside of the above villages and more rurally (but still within the study area) include A-Six Taxis and Thomson's scrap yard.
- 11.4.16. Development plans for South Norfolk, Breckland and Broadland districts have been considered to show any developments planned in, or within close proximity to, the study area.
- 11.4.17. Broadland District Council is currently preparing a Local Development Order (LDO) for a 46-acre area south of the A47 (between Blind Lane and Dereham Road) to help facilitate development at the Greater Norwich Food Enterprise Zone (FEZ). An LDO seeks to simplify the planning process in certain areas by allowing the Local Planning Authority to grant Planning Permission for certain forms of development. The LDO, in this instance, aims to provide greater flexibility for new food related business and institutions to be located within the site. According to a Cabinet meeting in May 2017, adoption of the LDO is likely to go ahead, subject to certain matters relating to the routing of HGVs and the request of an EIA Screening from the Secretary of State.
- 11.4.18. Hornsea Project Three offshore windfarm is also being proposed by Dong Energy. The proposals feature plans to lay an underground cable to the Norwich main substation from Weybourne on the coast. The cable, should the plans go ahead, would run through the study area in a southerly direction between Easton and Honingham, crossing the A47. The deadline for a decision on the planning application is the 31<sup>st</sup> March 2020.
- 11.4.19. According to the Breckland Council Local Plan Preferred Sites and Settlement Boundaries 2016, 25 residential dwellings are set to be built between 2026 and 2036. The site is located on 0.8 acres of agricultural land to the north of the A47, with access set to be gained from Heath Road. An alternative site has also been provided which is accessed via The Street.
- 11.4.20. The South Norfolk Local Plan states that 52.6ha of land has been allocated for housing and its associated infrastructure. The designated land is positioned to the south, east and west of Easton. The land will accommodate approximately 900 dwellings and a new village centre featuring recreation space, a post office and a village hall. The land will also be used for expanded primary school provision in agreement with the Education Authority. The Local Plan also states that 1.4ha of land has been allocated for a new gymnastics centre as a facility

for the Easton Gymnastics Club. The facility is set to be surrounded on three sides by the new residential dwelling site.

- 11.4.21. As well the above large-scale developments, a number of smaller scale residential developments are proposed in close proximity to the study area. According to Breckland District Council's Statement of Five Year Housing Land Supply, several sites in, and in close proximity to, Hockering are proposed to be used for housing. For example, land to the east of the playing field and west of Heath Road has permission for 18 dwellings to be built.

#### *Agricultural land holdings*

- 11.4.22. The information on agricultural land holdings has been taken from previous stages of design development and assessment and confirmed through the Natural England land capability for agriculture maps. No further desk study or site walkover has been possible.
- 11.4.23. The Natural England land capability for agriculture maps state that the quality of the agricultural land for the footprint and 250m buffer zone of the North Tuddenham to Easton scheme varies between Grade 4 (poor quality) to Grade 2 (very good quality), with two areas within the study area classified as non-agricultural land.
- 11.4.24. The occurrences and broad locations of the different grades of agricultural land as defined by Ministry of Agriculture, Fisheries and Food (MAFF) are summarised below:
- Grade 2 land is largely situated to the north and west of Hockering.
  - Grade 3 land dominates the majority of the remaining study area.

#### *Walkers, cyclists and horse riders (WCH)*

- 11.4.25. The existing WCH facilities in the study area are summarised in Table 11.1 and shown in Figure 11.1. The comprise Public Rights of Way (PRoW), (namely footpaths, bridleways and restricted byways), permissive routes and footways provided as part of the highway network.



Table 11.1: WCH facilities in the study area

Location Ref (Figure 11.1)	PRoW Reference (NCC)/Location	Description
1	North Tuddenham FP10	The public footpath runs from Main Road east of North Tuddenham in a north easterly direction connecting to bridleway North Tuddenham BR4. The route runs through a wooded area and fields.
2	Hockering FP12	The public footpath runs in a north – south direction between the A47 and Lyng Road. The route is approximately 20m long and follows a minor access on the A47.
3	Hockering FP10	The public footpath runs along the southern kerb line of The Street from the access junction with A47 west of Hockering for approximately 70m in a westerly direction.
4	Hockering FP2	The public footpath runs from The Street adjacent to St. Michael's Church and Cemetery in a northerly direction toward Lodge Farm adjacent to Hockering Wood. The run route along an existing track for its length.
5	Hockering FP3	The public footpath begins at St Michael's Church and Cemetery on The Street and runs in a generally southern direction passing through grounds of the church and the adjoining field before ending at The Street.
6	Hockering FP9	The public footpath runs from Heath Road, Hockering in a north-westerly direction passing through the village towards Hockering Wood. The route runs along a track through the village before running along field boundaries until Hockering Wood.
7	Hockering FP1	The public footpath runs between Rectory Road and Heath Road, Hockering in a north-westerly direction passing through the village along a track.
8	Hockering FP6	The public footpath runs from Heath Road north of Hockering in an easterly direction as far a Park Farm before heading north to connect with Hockering FP5. The route runs along an existing track for its length.
9	Hockering FP5	The public footpath runs from Park Lane at Hill House Farm adjacent to the A47 in a generally northerly direction before turning in a westerly direction as far as Heath Road. The route runs along an existing track before running through fields and along field boundaries to Heath Road.
10	Hockering FP11	The public footpath runs from The Street to the east of Hockering for approximately 30m in a southerly direction towards the A47. The route runs through a wooded area between the Street and the A47.
11	Hockering FP8	The public footpath runs from Mattishall Lane in the west to Hockering FP7 in the east. The route generally runs to the north of the River Tud through fields and a wooded area parallel to the river.
12	Hockering FP7	The public footpath runs from A47 immediately south of Hockering in a predominately southern direction connecting to Hockering FP8 and East Tuddenham FP10. The route runs along an existing track past the sewage works before following field boundaries and then crossing the River Tud.
13	East Tuddenham FP9	The public footpath runs between the end of Rotten Row in the east and Mattishall Lane in the west. The route generally runs to the south of the River Tud through fields parallel to the river.
14	East Tuddenham FP10	The public footpath runs in a northerly direction from Hall Lane in the south crossing East Tuddenham FP9 to a point immediately south of a drain for the River Tud where the footpath become Hockering FP7.
15	East Tuddenham FP8	The public footpath begins at Hall Lane immediately north of East Tuddenham and runs in a generally northern direction connecting to East Tuddenham FP9. The route predominately runs through fields and along filed boundaries.

Location Ref (Figure 11.1)	PRoW Reference (NCC)/Location	Description
16	East Tuddenham FP7	The public footpath runs between The Street, East Tuddenham to the south and Rotten Row to the north. The route runs through fields.
17	East Tuddenham FP6	The public footpath begins on Church Lane and runs in a westerly direction for approximately 200m and connects with East Tuddenham FP7. The route runs through a field.
18	East Tuddenham FP5	The public footpath to the south of Norwich Road, East Tuddenham. It then crosses Norwich Road and continues for approximately 800m in a northerly direction connecting with East Tuddenham FP3. The route runs predominately through fields.
19	East Tuddenham FP4	The public footpath begins at Norwich Road and runs in northerly direction and connects to East Tuddenham FP3. The route runs predominately through a wooded area.
20	East Tuddenham FP3	The public footpath begins at Berry's Lane and runs in a predominately westerly direction to Church Lane. The route is approximately 1.1km long and predominately runs through fields plus a small section of wooded area.
21	East Tuddenham FP2	The public footpath runs in an east –west direction between Wood Lane in the east and Sandy Lane in the west. The route runs along field boundaries between the two roads.
22	Honingham FP4	The public footpath begins in Honingham and runs between The Street in the east and Berry's Lane to the west. The route is approximately 730m long. It follows Mill Lane for its length before passing through the centre of a field and then continuing along the field boundary to Berry's Lane.
23	Honingham FP3	The public footpath is located to the east of Honingham and runs between Dereham Road in the east and Berry's Lane to the west. The route is approximately 330m long and follows a field boundary and the northern edge of the Merrywood House Residential Care Home grounds.
24	Hockering	Shared footpath / cycleway (2m wide) linking between Main Road and The Street to the west of Hockering. The majority of the route follows the northern frontage of the A47 from its junction with The Street in the east before heading north and connecting with Main Road in the west. The route is approximately 720m long.
25	Hockering	Footway on the southern frontage of the A47 between Mattishall Lane and The Street. The footway continues into Mattishall Lane as far as the residential properties. An uncontrolled crossing with pedestrian island is located on the A47 allowing pedestrians to cross on to a footway on the northern frontage of the street leading into Hockering.
26	Hockering	Footway on both frontages of The Street through Hockering as far as Meadow View to the east of the village. The footway on the northern frontage of The Street then continues past this point on to the A47 as far as Park Lane.
27	Honingham	Footways are present on Dereham Road, The Street and Norwich Road through the village of Honingham.
28	A47 east of Honingham	Footway on the northern frontage of the A47 running between Taverham Road in the east and the Norwich Road roundabout in the west. The footway crossing the roundabout on the western arm of the A47 and continues along Norwich Road for approximately 120m.
29	Easton	Footway on the northern frontage of Church Lane/Dereham Road leading to the A47/Church Lane roundabout from Easton village. The footway continues across the A47 via two uncontrolled crossings on the A47(E) arm of the roundabout for approximately 200m further north.

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Location Ref (Figure 11.1)	PRoW Reference (NCC)/Location	Description
		Footways are present on both frontages of Dereham Road heading in to Easton.
30	North Tuddenham BR4	The bridleway runs in an east –west direction between Lynd Road in the east and Hall Lane in the west passing through White House Farm. The route run on existing access tracks through the farm.
31	Honingham RB1	The restricted byway runs between Dereham Road immediately west of Honingham to the south and Wood Lane to the north in a generally northern direction. The route runs through a mixture of fields, wooded areas and along an existing track. The A47 severs the route approximately 220m north of Dereham Road. No crossing facilities are provided at the A47.

- 11.4.26. No WCH surveys have been undertaken to date but surveys are proposed for April 2020 to provide usage data for the PRoW directly affected by the Proposed Scheme and for other key locations where WCH activity could occur on the affected local highways.

### *Human Health*

- 11.4.27. The community profile and environmental baseline gathered to date is set out under human health. In particular, where this may have an impact on health. The information in this section will be used to determine the sensitivity of communities and the key health determinants to be used in the assessment.

### *Health Profile*

- 11.4.28. Human health profiles for Breckland, Broadland and South Norfolk Districts will be provided within the ES.
- 11.4.29. Across the three districts, the health of the local communities is generally better than the England average. However, some key health issues affecting local communities (relevant to the Proposed Scheme) appear to be:
- fatalities and seriously injured on the roads
  - percentage of physically active adults.
- 11.4.30. Further information on health profiles will be gathered through further desk-based research (using sources such as Census data and the Office of National Statistics) and stakeholder consultation. This information will be detailed within the ES.

### *Community, recreational, educational and healthcare facilities*

- 11.4.31. Connectivity to facilities used by local communities (as described above under Community Land and Assets) is an important consideration in the health assessment. The impact of the Proposed Scheme on community connections to key facilities will be considered as part of the health assessment.

### *Green/open space*

- 11.4.32. The green/open space baseline for the ES will largely use information provided as part of community land and assets but will be supplemented by text to outline the severance/ separation of communities from such facilities.

### *Transport network*

- 11.4.33. Usage data for the WCH facilities is not available as surveys are proposed to be undertaken in April 2020.

11.4.34. Table 11.2 summarises the available bus stops located in the immediate vicinity of the Proposed Scheme. The locations of these bus stops are shown in Figure 11.1. There are no other transport interchanges, bus stations or railway stations located within the vicinity of the extents of the Proposed Scheme.

Table 11.2: Bus stop locations and services

Bus Stop Location	Location	Bus Service	Route
Dereham Road, Easton (E/B)	490m east of the junction with the A47	4	N & NU Hospital Norwich Bus Station
		52	Easton College
		X1	Norwich Bus Station
Dereham Road, Easton (W/B)	390m east of the junction with the A47	4	Honingham East Tuddenham Mattishall Yaxham Dereham Swanton Morley
		52	Swaffham
		X1	Dereham Swaffham King's Lynn Wisbech Peterborough
Mattishall Road, Honingham (E/B)	750m west of the junction with the A47	4	Easton N & NU Hospital Norwich Bus Station
Mattishall Road, Honingham (W/B)	750m west of the junction with the A47	4	East Tuddenham Mattishall Yaxham Dereham Swanton Morley
The Street, Hockering	350m east of the junction with the A47	X1 (E/B)	Easton Norwich Bus Station
		X1 (W/B)	Dereham Swaffham King's Lynn Wisbech Peterborough
Eisling Road (The Lodge), North Tuddenham (E/B)	475m east of the junction with the A47	8	Norwich City Centre
		80	Sparham Reepham Aylsham
		8	Dereham

Bus Stop Location	Location	Bus Service	Route
Eisling Road (The Lodge), North Tuddenham (W/B)	475m east of the junction with the A47		Litcham
		80	Dereham

### *Air quality*

- 11.4.35. Poor air quality is a significant contributor to health issues within local communities, as long-term exposure can lead to chronic conditions such as cardiovascular and respiratory diseases as well as lung cancer, thereby affecting life expectancy. Air pollutants associated with road traffic include Nitrogen Dioxide (NO<sub>x</sub>) and Particulate Matter (PM<sub>10</sub> and PM<sub>2.5</sub>).
- 11.4.36. Chapter 4 of this document sets out the air quality baseline. The outcome of the air quality assessment will be used to inform the health assessment. Any potential impacts will be reported within the ES.

### *Noise*

- 11.4.37. Traffic noise has a variety of health effects and is recognised by the World Health Organisation as a serious public health problem. Sensitive groups to noise include children, the elderly, and those with existing health issues.
- 11.4.38. There are numerous noise sensitive receptors in the study area, located within the main towns and villages and scattered properties. These will be outlined in the Noise and Vibration chapter for the ES. In addition to dwellings, churches and community facilities, two specialist schools and a care home are located in Honingham. Four Noise Important Areas fall within the study area, indicating noise is already an important issue for local communities. The impact of the Proposed Scheme on the local communities and in particular highly sensitive groups, will be considered as part of the health assessment.

### *Pollution*

- 11.4.39. Pollution in relation to surface and groundwater is discussed in Chapter 12 Road Drainage and the Water Environment.
- 11.4.40. Disturbance to contaminated land can have risk to human health. The source, pathway, receptor assessment will be undertaken as part of the Geology and Soils assessment. Refer to Chapter 8 for further information.
- 11.4.41. Information regarding water and contamination pollution will be used to inform the health assessment where relevant.

### *Landscape amenity*

- 11.4.42. The existing surrounding landscape and visual receptors are described in Chapter 6. Whilst it is well-known that being in nature is beneficial for human mental health, there is a lack of definitive guidance. Further discussion with Highways England will be undertaken to agree the approach to this part of the health assessment.

### *Road safety record of affected road network*

- 11.4.43. Records of collisions over the length of the existing A47 comprising the Proposed Scheme, namely between grid reference 605633,313670 and grid reference 613527,311025 for the 5-year period between 3 January 2014 and 12 December 2018 have been reviewed to identify notable trends, or significant road safety issues.
- 11.4.44. A total of 63 collisions were recorded in the study area, of which 54 were classified as slight severity and 9 were classified as serious. No fatalities were recorded during the time period reviewed. Additionally, no collisions involving pedestrians, cyclists or horse-riders were recorded.
- 11.4.45. An examination of the location and occurrence of the collisions highlights a number of clusters along the A47. These clusters are located at the A47 - Wood Lane - Berry's Lane crossroads where four collisions of slight severity and a single collision of severe severity were recorded; at the A47 - Taverham Road - Blind Lane crossroads where five collisions of slight severity and a single collision of severe severity were recorded and on the A47 close to the Church Lane - Dereham Road roundabout where five collisions of slight severity and a single collision of severe severity were recorded.

## **11.5. Consultation**

- 11.5.1. Stakeholder consultation will be undertaken to inform the assessments within this chapter. For the health assessment in particular, input from different population groups will be essential to ensure the key health determinants have been identified.
- 11.5.2. No further consultation has been undertaken with respect to WCH since receipt of the Scoping Opinion.



## 11.6. Scheme considerations

### Potential impacts

#### *Private property and housing*

- 11.6.1. The Proposed Scheme is not predicted to result in a loss of private properties. There is the potential for impacts to occur to land allocated for housing as a result of the temporary and permanent land take required for the Proposed Scheme. However, the full impact and residual effect will be determined within the ES.

#### *Community land and assets*

- 11.6.2. No adverse impacts to community land or community facilities are predicted with the Proposed Scheme. However, this will be assessed with the developed design within the ES.

#### *Development land and businesses*

- 11.6.3. Potential impacts may arise to areas of development land as a result of permanent or temporary land take associated with the Proposed Scheme. Full impacts associated with this will be assessed and reported within the ES.

#### *WCH*

- 11.6.4. The Proposed Scheme would have a direct impact upon users of the restricted byway referenced as Honingham RB1 (public right of way (PRoW) 31) and the footpath referenced as Hockering FP7 (PRoW 12) since it would sever both routes. This would result in increased journey times and lengths during the temporary construction period.
- 11.6.5. The strategies to be adopted as part of the Proposed Scheme to mitigate the impacts on the PRoW identified above seek to either maintain as far as is possible the route of the PRoW and where this is not practical, permanently divert the route to alternative facilities. In proposing a diversion to a route, the objective has been to limit the additional journey time and length to the alternative facilities. The magnitude of the potential impacts of the Proposed Scheme would therefore be either beneficial or minor adverse, depending upon the strategy to be adopted for each PRoW.
- 11.6.6. The Proposed Scheme would have a beneficial effect in respect of road safety.

#### *Health*

- 11.6.7. At this stage, it is considered the Proposed Scheme has potential to impact both adversely and beneficially on local communities in the context of the following health determinants:

- access to community and healthcare facilities.
- access to outdoor areas/greenspace.
- noise and air quality impacts on vulnerable groups.
- road safety

11.6.8. These health determinants will be further considered, and updated, as more information becomes available.

11.6.9. The sensitivity of the local community will be identified based on the health profiling information gathered and information from stakeholder consultation.

11.6.10. A qualitative assessment of human health will be undertaken during summer 2020 and reported in the ES. The qualitative assessment will use information gathered from the Statutory Consultations in 2020. Information from the other EIA topics will be used to determine the likely health outcomes, which will be reported in the ES.

## Potential mitigation

### *Private property and housing*

11.6.11. Any adverse impacts to private properties will be identified and mitigated through design development where possible.

### *Community land and assets*

11.6.12. Mitigation measures to reduce the potential impacts to identified severance between communities and their land or assets will be undertaken during design development and reported within the ES.

### *Development land and businesses*

11.6.13. Any adverse impacts to development land and businesses will be identified and mitigation through design development where possible.

### *WCH*

11.6.14. The strategy proposed for Honingham RB1 is to permanently divert a short section of the route lying to the north of the A47, eastwards, to a new underpass that would be provided as part of the Proposed Scheme to accommodate a private access track. Users of the PRoW could then pass beneath the new A47 alignment on a shared use path, which would have restricted byway status and connect to the former A47 carriageway.

11.6.15. The former A47 would be abandoned as a highway and become a shared use facility except for the section between the private access track and a new access

track providing a connection to Dereham Road. Once users have passed beneath the underpass, they could then utilise the downgraded former A47 carriageway to reconnect to the section of Honingham RB1 running south from the former A47 carriageway. Although the permanent diversion of this PRoW would lead to a small increase in journey time and length, the proposed mitigation would have a beneficial effect in that it would provide a safe, grade separated crossing of the new A47 alignment for all users.

- 11.6.16. The strategy for Hockering FP7 is to permanently divert the route of the PRoW since it is not practical to maintain the alignment of the route along Gypsy Lane. A new section of footpath, running east to west, is proposed to the south of the new A47 alignment and this would provide a connection between Hockering FP7 and Church Lane to the east. Church Lane would be severed by the Proposed Scheme but an underpass is proposed at Church Lane for use by pedestrians and cyclist. Users can then utilise facilities provided as part of the former A47 to access Hockering.

## 11.7. Summary

- 11.7.1. Table 11.3 provides a summary of potential construction and operational stage effects on population and health for the Proposed Scheme.

Table 11.3: Summary of potential population and human health effects

Topic	Summary
Private property and housing	Potential for direct impacts to land allocated for housing. No property demolition is identified as a part of the Proposed Scheme.
Community land and assets	No direct impacts are predicted to areas of community land and facilities, however the potential for severance will be identified in the ES.
Development land and businesses	Potential impacts to land allocated for development land may occur as a result of the Proposed Scheme. It is not predicted that there would be land take required to the identified businesses.
WCH	Construction: Direct impact on upon users of Honingham RB1 and Hockering FP7 (PRoW 31 and 12) since it would sever both routes. This would result in increased journey times and lengths during the temporary construction period. Operation: Direct impact on users of Honingham RB1 and Hockering FP7 (PRoW 31 and 12) since it would sever both routes. The mitigation strategies to be adopted as part of the Proposed Scheme would result in either beneficial or minor adverse effects.
Access to community and healthcare facilities	Journey length changes will be experienced by the local community to access community and healthcare facilities. The ES will identify the effect of journey changes to community and healthcare facilities on the health of the local community, in particular on vulnerable groups.
Access to outdoor areas/greenspace	Journey length changes will be experienced by the local community to access outdoor areas/greenspace. The ES will identify the effect of journey changes to outdoor areas/greenspace on the health of the local community, in particular on vulnerable groups.

Topic	Summary
Noise and air quality impacts on vulnerable groups	Effects will be determined following the air quality and noise and vibration assessments. It is likely some community groups will experience beneficial effects and others adverse, depending on their location and traffic distribution.
Road safety	The Proposed Scheme would have a beneficial effect in respect of road safety.
Other health effects	To be determined following further desk-top research and stakeholder consultation.

## 12. Road drainage and the water environment

### 12.1. Introduction

- 12.1.1. This chapter considers the existing environmental baseline information with respect to road drainage and the water environment, together with water abstraction. This chapter describes the potential impacts that are anticipated from preliminary assessments in relation to the Proposed Scheme, and the outline proposed design and other measures to help mitigate these potential impacts.

### 12.2. Assumptions and limitations

- 12.2.1. This report has been prepared using publicly available information, with reference to previous reports carried out and Highway England's Drainage Data Management System (HADDMS). The information gathered for the baseline is derived from a desk-based study and a site walkover carried out in December 2019. Considering the nature of the Proposed Scheme, it is not considered that the data limitations introduce any significant uncertainties with respect to the surface water, ground water and flood risk. Further site visits will be carried out as part of the ES.
- 12.2.2. It is assumed that significant in-channel works and a river diversion would be necessary on the River Tud, east of Honingham where a bridge is required as part of the Proposed Scheme, and also at a crossing over a smaller Ordinary Watercourse to the south of Hockering.
- 12.2.3. It is assumed that temporary watercourse crossings would be required as part of the Proposed Scheme.

### 12.3. Methodology

- 12.3.1. The proposed methodology will follow the guidance provided in the Design Manual for Road and Bridges (DMRB) Volume 11, Section 3, Part 10, LA 113: Road drainage and the water environment for assessing the significance of effects of proposed road schemes on the road drainage and water environment. The following proposed methods will be adopted:
- Simple assessment of pollution impacts from routine run-off to surface waters using the Highways England Water Risk Assessment Tool (HEWRAT) to determine whether the risk is acceptable.
  - If the discharge fails the HEWRAT assessment, and proportionate mitigation cannot be readily incorporated, a detailed assessment shall be carried out using the UKTAG Rivers and Lakes Metal Bioavailability Assessment Tool

- A simple hydrogeological assessment shall be undertaken to determine the impacts to groundwater in terms of water quality (routine runoff and spillage), groundwater levels and flows, and groundwater dependent terrestrial ecosystems.
- Assessment of pollution impacts from spillages will be undertaken using HEWRAT.
- A hydromorphological assessment shall be undertaken to determine whether the degree of hydromorphological change is acceptable.
- The Flood Risk Assessment (FRA) will be undertaken in accordance with the requirements of the National Planning Policy Framework (NPPF) and the Environment Agency's climate change allowances. A hydrological assessment of design floods for the River Tud and a hydraulic assessment of the River Tud including existing and proposed hydraulic structures (that is, culverts and bridges) will be undertaken.

12.3.2. A drainage strategy will be prepared for the Proposed Scheme which will detail outfall locations, any attenuation requirements and the inclusion of sustainable drainage systems (SuDS) features, where appropriate. The results of the drainage strategy will be used to inform the environment assessment and the FRA.

12.3.3. The construction, operation and demolition stages could result in potential adverse direct effects on water bodies classified under the Water Framework Directive (WFD) and therefore a preliminary WFD compliance assessment will be required to inform the requirement for more detailed assessments.

## **12.4. Baseline**

### **Study area**

12.4.1. The study area comprises a 1km buffer around from the land within the proposed site boundary. The study area may be extended to include downstream water environment features beyond 1km if they are deemed to be at significant risk from either the construction or operation phases. The full extent of the study area will be confirmed as part of the ES when further design details are available.

### **Survey and baseline information**

12.4.2. Surveys will be undertaken as part of the assessment. This will be reported in the ES.

### *Local environment*

12.4.3. The main water features within the study area are within the River Tud WFD catchment area (GB105034051000, Environment Agency, 2019a). The

Proposed Scheme crosses the River Tud at one location to the east of Honingham and a tributary of the River Tud south east of Hockering. There are numerous smaller drainage channels and isolated ponds within the study area. Run off from the existing A47 drains to seven outfalls either directly into the River Tud or via tributaries of the River Tud and nine soakaways. Surface water at the northern junction of Sandy Lane is directed to a catch pit via a gully pot (Highways England, 2019a).

12.4.4. According to the Environment Agency (Environment Agency, 2020a) the majority of the Proposed Scheme is within Flood Zone 1, which is associated with a low risk of flooding from rivers and sea (see Figure 12.1). A small proportion of the Proposed Scheme is within Flood Zone 2, which is associated with medium risk of flooding from rivers and sea and Flood Zone 3, which is associated with high risk of flooding from rivers:

- The Scheme crosses the River Tud and its associated Flood Zone 3b (classified as the functional floodplain and is considered to be the highest risk of flooding from rivers and sea) east of Honingham.
- The Scheme crosses a tributary of the River Tud and its associated Flood Zone 3a (which is associated with high risk of flooding from rivers and sea) south east of Hockering.
- An area of Flood Zone 3a is within the proposed site boundary at Berry's Lane, east of Honingham.

12.4.5. There are isolated areas of low and medium risk of surface water flooding originating from local land drains and three areas of high surface water flood risk (Environment Agency, 2020b) (see Figure 12.2):

- South east of Hockering originating from a drain running adjacent to the River Tud.
- East of Hockering (near the Sandy Lane Junction) due to a depression in the land which would collect overland flow.
- North and east of Honingham originating from the cluster of drains and the River Tud.

12.4.6. Based on British Geological Online Geology Maps (British Geological Society, 2019) the Proposed Scheme is underlain by:

- secondary (Undifferentiated) aquifer: Lowestoft Formation (Diamicton).
- secondary A aquifers: Alluvium, Lowestoft Formation Sand and Gravels and Sheringham Cliffs Formation Sand and Gravels.

12.4.7. Secondary (undifferentiated) aquifer classifications are given to geological formations with variable characteristics and can therefore be used to provide



water supply in some locations but be found to be unproductive in other locations. Secondary A aquifer classifications are given to geological formations that provide water supply and baseflow at a local scale.

- 12.4.8. The bedrock geology underlying the study area comprises undifferentiated formations within the White Chalk Subgroup across its full extent. This aquifer is designated a Principal Aquifer. Principal Aquifer classifications are given to geological formations that provide water supply and river baseflow on a regional scale.
- 12.4.9. The groundwater within the study area is part of the Broadland Rivers Chalk and Crag WFD groundwater body (GB40501G400300).
- 12.4.10. The proposed route crosses zones of potential for groundwater flooding (Highways England, 2019a) in two locations along the Proposed Scheme. These are to the southeast of Hockering village and to the east of Honingham, where the route crosses the River Tud (see Figure 12.3).

#### *Designated sites*

- 12.4.11. The River Wensum Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC; UK0012647, Defra, 2017) is located, at its closest, 1.6km north east of the proposed site boundary but approximately 7.3km downstream of the study area. Although this lies out of the study area it has been considered as a potentially sensitive receptor due to the contribution of flow or changes in water quality from the River Tud to the River Wensum and it potentially receives baseflow from the underlying Principal Chalk and Secondary Superficial aquifers.
- 12.4.12. Seven Priority Habitat Lowland Fens are present within the study area. The Lowland Fens receive water and nutrients from the soil, rock and groundwater. A Priority Habitat Coastal and Floodplain Grazing Marsh is present at the location where the proposed river crossing is planned.

#### *Sensitive receptors*

- 12.4.13. The current Anglian River Basin Management Plan (RBMP) (Environment Agency, 2019a), provides information on three WFD water bodies that have the potential to be impacted upon:
- The River Tud (water body reference: GB105034051000) runs in an easterly direction south of the A47, crossing under the carriageway at Honingham and is a tributary of the River Wensum (Wensum DS Norwich, water body reference: GB105034055882). This water body is classified as a Heavily Modified Water Body with 'Moderate' ecological potential and 'Good' chemical status. The ecological potential is limited by physio-chemical quality elements

(phosphate) not achieving 'Good' potential. The overall water body status is classified as 'Moderate' and is not expected to improve as it would be disproportionately expensive to achieve.

- The River Wensum (Wensum DS Norwich) is located to the east of the Proposed Scheme and runs in a south easterly direction. Although the study area does not impinge on this water body it has been identified as an indirect receptor. Immediately upstream of the confluence with the River Tud, the River Wensum is defined as a separate water body (Wensum US Norwich, water body reference: GB105034055881). This water body is classified as a Heavily Modified Water Body with 'Moderate' ecological potential and 'Good' chemical status. The ecological potential is limited by biological quality elements (macrophytes and phytobenthos combined) and surface water supporting elements (mitigation measures assessment) not achieving 'Good' potential. The overall water body status is classified as 'Moderate' and has an overall objective to achieve 'Good' potential by 2027.
- The Proposed Scheme is located within the Broadland Rivers Chalk and Crag groundwater body (water body reference: GB40501G400300). This water body is identified as having 'Poor' chemical and quantitative status. The quantitative status is limited by the Groundwater Dependent Terrestrial Ecosystems test which scored poorly due to agricultural abstractions lowering the natural flow and levels of the groundwater. The chemical status is limited by the Chemical Drinking Water Protected Areas criteria, which scored poorly due to suspect data. The overall water body status is classified as 'Poor' and has an objective to achieve 'Good' status by 2027.

12.4.14. The above WFD water bodies are protected under the Nitrates Directive and are located in the Nitrate Vulnerable Zones (Environment Agency, 2019b). The River Wensum and Broadland Rivers Chalk and Crag groundwater body are linked to Drinking Water Protected Areas (Environment Agency, 2019a).

12.4.15. The Proposed Scheme crosses a source protection zone (SPZ) 3 (Total Catchment) at the eastern extents of the route (see Figure 12.3). This is associated with major groundwater abstractions to the northeast, south and southeast of the scheme that are used for public water supply. Further areas of SPZ 3 are present within the proposed site boundary, located to the north and south of the Proposed Scheme and again are associated with public water supply abstractions beyond the 1km study area (Defra, 2019).

12.4.16. A new source for public water supply (which was highlighted by the Environment Agency and Anglian Water in their response to the Scoping Report) is located to the south of the River Tud on land adjacent to Church Lane in East Tuddenham. Currently the Environment Agency's SPZ map has not been updated, although initial catchment modelling by Anglian Water indicates that the groundwater capture zone (and hence SPZ 3 definition) extends across the A47.

12.4.17. There are a large number of private groundwater abstractions within the study area, the majority of which abstract from the Chalk, although some abstract groundwater from the overlying sands and gravels. In addition to this, there are 17 surface water abstraction licences located within the Proposed Scheme area, the majority of which are taken from the River Tud and its tributaries. The majority of these are used for general agricultural and domestic purposes. There are a small number of consented discharges to groundwater within the study area. These are primarily for private sewage treatment (for example, septic tanks). There are also approximately 25 consented discharges to surface water: 13 from domestic properties, 11 from waste water treatment works and one from a pumping station on a sewerage network.

## 12.5. Consultation

12.5.1. The EIA Scoping Report was issued to the Planning Inspectorate in September 2019 to inform its Scoping Opinion. The following organisations responded to the Planning Inspectorate consultation in the Scoping Opinion with specific comments on the Road Drainage and Water Environment:

- Anglian Water
- East Tuddenham Parish Council
- Environment Agency
- Hockering Parish Council
- Honingham Parish Council
- Norfolk County Council
- Water Management Alliance (on behalf of Norfolk Rivers Internal Drainage Board)

12.5.2. Key points raised as part of the Scoping Opinion include design criteria regarding bridge works with both the Environment Agency and Norfolk County Council noting that culverting should be avoided. The Environment Agency strongly recommended that significant in-channel works and river diversions were avoided, and if they were to progress, a Water Framework Directive assessment would have to prove that the Proposed Scheme results in an overall improvement to the water environment. The lifetime of the Proposed Scheme would need to be determined in order to apply the correct climate change projections for flood risk.

12.5.3. The ES is to include a FRA, considering all sources of flooding and providing at least one feasible solution for the disposal of water, a hydrogeological assessment to assess the potential impact of any changes to groundwater levels

and flows on abstractions and surface water, and an assessment of the pollution impact of routine road runoff to surface water and groundwater.

- 12.5.4. Ongoing consultation will be carried, when required with appropriate consultees during the statutory consultation period for the Proposed Scheme. This will be reported within the ES.

## **12.6. Scheme considerations**

- 12.6.1. The Proposed Scheme requires a new road drainage design, which is yet to be finalised and it is assumed that only a small section of the existing A47 drainage would be utilised where it ties in with the current road at either end of the Proposed Scheme.
- 12.6.2. The proposed drainage design would incorporate features to mitigate against the potential for an increase in flood risk, a deterioration in water quality within the water environment, or a reduction of groundwater resources available to abstractions or groundwater-dependent surface water features. The proposed drainage is being designed however, 11 drainage basins have been proposed along the Proposed Scheme.
- 12.6.3. Further design interventions may be required and identified during the design process and preparation of the ES.

## **Potential impacts**

- 12.6.4. The potential impacts of the Proposed Scheme during construction, without mitigation practices in place, include the following:
- Damage to aquatic ecosystems, due to the pollution of watercourses and groundwater. Pollution may arise from mobilised sediment and contaminants as a result of road construction activities such as earthworks (including foundation works), construction dewatering, plant and vehicle washing, alterations to ground levels, or accidental spillages or leaks of fuel, oil, chemicals, wastewater, concrete or cement products. Such impacts also have the potential to affect indirect receptors such as nearby groundwater abstractions or the River Wensum SSSI and SAC located downstream of the River Tud.
  - Increased risk of flooding due to changes in the extent of the floodplain or changed / new flood pathways as a result of temporary barriers created by construction works e.g. topsoil stockpiles, in river works or river diversions.
  - Temporary changes in the surface water run-off regime by the alteration of ground elevations and overland flow pathways, for example, by earthworks or proposed structures.

- 12.6.5. Other potential construction effects may be identified during the preparation of the ES when further details on the Proposed Scheme drainage are available.
- 12.6.6. The potential effects of the Proposed Scheme during the operation phase, without design intervention and mitigation in place, include:
- Potential increase in the peak flow rate and volume of highway run-off and a subsequent increase in downstream flood risk from an increase in impermeable area.
  - Permanent changes in the land drainage and surface water run-off regime and associated flood risk (including groundwater flood risk) by the alteration of ground elevations and overland flow pathways, for example, by earthworks or proposed structures.
  - Permanent changes to the groundwater flow regime as a result of any underground structures such as foundations. These changes may in turn affect the amount of water available for indirect receptors such as nearby abstractions or groundwater-dependent surface water features.
  - Permanent changes in flood risk, water quality, aquatic ecosystems and WFD status due to a potential river diversion, in channel work and loss of floodplain storage associated with the proposed bridge at the River Tud and a crossing over a smaller Ordinary Watercourse to the south of Hockering.
- 12.6.7. Other potential operational effects may be identified during the preparation of the ES when further details on the Proposed Scheme drainage are available.

### Potential mitigation

- 12.6.8. During construction, best practice guidelines and procedures for pollution prevention and water management would be included as part of the overall CEMP. The CEMP would incorporate best practice as set out in the Construction Industry Research and Information Association (CIRIA) guideline documents<sup>8</sup>; the Environment Agency's pollution prevention guidelines for businesses (EA, 2019d); and the Environment Agency's approach to Groundwater Protection (Environment Agency, 2020c).
- 12.6.9. The adoption of such guidelines and procedures will mitigate against the majority of potential construction impacts to the natural water environment. The CEMP will also include details of best practice construction methods to minimise the potential impact of foundation piling on groundwater quality or groundwater flooding risk on ground stability, for example.
- 12.6.10. Where works result in temporary changes to the surface water run-off regime, a temporary surface water drainage strategy would be developed and incorporated

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<sup>8</sup> CIRIA C532 (CIRIA, 2002), CIRIA C648 (CIRIA, 2006), CIRIA C741 (CIRIA, 2015a) and CIRIA C753 (CIRIA, 2015b)

into the CEMP. This will ensure that there is no increase in run-off and flood risk during the construction phase. The temporary drainage strategy would ensure that sediment and other pollutants, mobilised during construction, will not impact on the water quality of receiving watercourses. SuDS would be incorporated to this temporary surface water drainage strategy, where appropriate.

- 12.6.11. Any construction activities on or near an Ordinary watercourse or a watercourse managed by the Internal Drainage Board (IDB) would require consent from the Lead Local Flood Authority or the IDB as appropriate. Any construction activities on or near a Main River would require an Environmental Permit from the Environment Agency. Any works on or near to a public sewer would require consent from Anglian Water.
- 12.6.12. A detailed assessment of the proposed bridge to the east of Honingham and other river crossings will be required to ensure the design of the potential channel diversion and structures do not cause an adverse impact and aim to improve the overall status of the River Tud, where possible. Compensatory flood storage would be required to mitigate the impact of any loss of floodplain storage which could potential increase flood risk upstream and downstream. Further discussions will be held with the Environment Agency to ensure that their concerns raised in the Scoping Opinion are addressed.
- 12.6.13. To mitigate against the potential increases in flood risk and impacts on water quality, appropriate attenuation and treatment would be added to the drainage design. The attenuation and treatment would be provided using SuDS, designed using the SuDS Manual (CIRIA, 2015b), and would include an allowance for climate change (up to 40%) in their design. The drainage design would also take into account potential seepages that may occur in areas susceptible to groundwater flooding, and especially where cuttings may intercept shallow groundwater.
- 12.6.14. Water quality monitoring of the potentially impacted surface water features will be undertaken prior to construction, and then during and following construction, to ensure that the mitigation put in place is effective.
- 12.6.15. Further mitigation measures may be required and identified during the preparation of the ES when further details on the Proposed Scheme are available.

## 12.7. Summary

- 12.7.1. This chapter has summarised the current understanding of the baseline conditions, mitigation and likely anticipated impacts upon road drainage and the

water environment. The Proposed Scheme would potentially impact water receptors due to:

- Contamination of groundwater and surface water during construction and operation
- Changes to runoff, drainage and flood risk during construction and operation
- Reduction in groundwater resource to abstractions and groundwater dependent surface water features
- Pollution of groundwater and surface water during operation due to routine road runoff or accidental spillages

12.7.2. The mitigation will be designed to reduce such impacts to levels not considered to be significant.

12.7.3. Further work will be undertaken to develop design interventions to limit or reduce the impacts and promote opportunities for the environment within the study area wherever possible. The ES will report on design development and potential mitigation, as well as providing further details of the baseline conditions. The ES will also report on the likely changes during both construction and operation for all receptors identified.



## 13. Climate

### 13.1. Introduction

- 13.1.1. This chapter presents the preliminary findings of the Climate assessment. This comprises a review of the existing climate information and identification of the potential climate impacts associated with the Proposed Scheme.
- 13.1.2. To align with the requirements of the Infrastructure Planning EIA Regulations 2017, the National Networks National Policy Statement (NNNPS) 2014, and the Design Manual for Roads and Bridges Volume 11, Section 3, Part 14 (LA 114 Climate) guidance, the chapter covers two separate aspects:
- Effects on Climate – i.e. potential impacts on climate from carbon emissions arising from the Proposed Scheme, including how the project may affect the ability of the Government to meet its carbon reduction targets (in accordance with NNNPS paragraph 5.17).
  - Vulnerability of the Proposed Scheme to climate change – i.e. the resilience of the Proposed Scheme to climate change and associated weather effects, including how the Proposed Scheme will take account of the projected impacts of climate change (in accordance with NNNPS paragraph 4.40 and the Infrastructure Planning EIA Regulations 2017).
- 13.1.3. For the purposes of this report, the term ‘carbon’ will be used as shorthand to refer to all relevant Greenhouse Gas (GHG) emissions.
- 13.1.4. The following guidance documents have also been used to inform the assessment:
- Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 14, LA 114 Climate (DMRB, 2019)
  - Climate Adaptation Risk Assessment Progress Update (Highways England, 2016)
  - IEMA Environmental Impact Assessment guide to Climate Change Resilience and Adaptation (IEMA, 2015)
  - IEMA's Guidance on Assessing the GHG Emissions and Evaluating their Significance (IEMA, 2017)
  - Transport Analysis Guidance (TAG) Unit A3 Environmental Impact Appraisal (DfT, 2015) Chapter 4 Greenhouse Gases
  - Publicly Available Specification (PAS) 2080:2016 Carbon Management in Infrastructure (British Standards Institution, 2016)

## **13.2. Assumptions and limitations**

- 13.2.1. Data pertaining to the climate baseline and future projections are based on available information from third parties, including historical meteorological variables recorded by the Met Office and the UK Climate Projections (UKCP18) developed by the Met Office.
- 13.2.2. Uncertainty is inherently associated with climate change projections, as they are complex in nature and based upon various assumptions including future global emissions trajectories. The level of uncertainty associated with projections also varies between climate variables. For example, projections related to wind and extreme weather events are considered more uncertain than those pertaining to temperature and precipitation. Similarly, the degree of uncertainty associated with all climate change projections increases with time.

## **13.3. Methodology**

### **Effects on Climate**

- 13.3.1. The Climate Change Act (2008) sets legally binding targets for reducing the UK's carbon emissions by at least 100% by 2050 (net zero), relative to a 1990 baseline. The EIA Directive (2014/52/EU) and subsequent updates to UK EIA regulations now include a requirement to assess the impacts of projects on climate and their vulnerability to climate change.
- 13.3.2. The assessment of the effects of the Proposed Scheme on climate will include:
- Estimation of the carbon emissions associated with Proposed Scheme construction using the Highways England Carbon Tool v2.2.
  - Estimation of the carbon emissions associated with Proposed Scheme operational energy using the Highways England Carbon Tool and 2019 UK GHG conversion factors.
  - Estimation of the carbon emissions associated with Proposed Scheme user utilisation in line with Chapter 4 Air Quality.
  - Assessment of significance of effects through comparing estimated carbon emissions arising from the Proposed Scheme with UK carbon budgets and the associated reduction targets .
  - Opportunities for mitigation in the Proposed Scheme design.

### **Vulnerability of the Proposed Scheme to climate change**

- 13.3.3. A qualitative methodology for assessing the vulnerability of Proposed Scheme assets to climate change has been produced following DMRB Volume 11 Section 3 Part 14 (LA 114). The assessment will include the following:

- Impacts (hazards and opportunities) for each receptor have been identified using Met Office climate projection data. The vulnerability of the Proposed Scheme to both normal weather and extreme weather-related disaster scenarios throughout the project lifecycle have been identified and reported.
- Following identification of climate change impacts (hazards and opportunities), a risk assessment of those impacts on the Proposed Scheme has been undertaken using the following framework outlined in Table 13.1 (likelihood categories) and Table 13.2 (measure of consequence).
- Significance of effects has been reported using Table 13.3 (significance matrix).

Table 13.1: Likelihood categories

Likelihood category	Description (probability and frequency of occurrence)
Very high	The event occurs multiple times during the lifetime of the Proposed Scheme (60 years) for example approximately annually, typically 60 events.
High	The event occurs several times during the lifetime of the Proposed Scheme (60 years) for example approximately once every five years, typically 12 events.
Medium	The event occurs limited times during the lifetime of the Proposed Scheme (60 years) for example approximately once every 15 years, typically 4 events.
Low	The event occurs during the lifetime of the Proposed Scheme (60 years) for example once in 60 years.
Very low	The event may occur once during the lifetime of the Proposed Scheme (60 years).

**Notes:** Proposed Scheme lifetime is considered to include construction and operational stages. Proposed Scheme lifetime is taken to be 60 years in line with the appraisal period outlined in HE guidance.

Table 13.2: Measure of consequence

Consequence of Impact	Description
Very large adverse	National level (or greater) disruption to strategic route(s) lasting more than 1 week.
Large adverse	National level disruption to strategic route(s) lasting more than 1 day but less than 1 week. OR Regional level disruption to strategic route(s) lasting more than 1 week.
Moderate adverse	Regional level disruption to strategic route(s) lasting more than 1 day but less than 1 week.
Minor adverse	Regional level disruption to strategic route(s) lasting less than 1 day.
Negligible	Disruption to an isolated section of a strategic route lasting less than 1 day.

Table 13.3: Significance Matrix

		Measure of Likelihood				
		Very low	Low	Medium	High	Very High
Measure of Consequence	Negligible	NS	NS	NS	NS	NS
	Minor	NS	NS	NS	<b>S</b>	<b>S</b>
	Moderate	NS	NS	<b>S</b>	<b>S</b>	<b>S</b>
	Large	NS	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>
	Very Large	NS	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>

**Notes:** NS = Not significant, S = Significant

## 13.4. Baseline

### Study area

#### *Effects on climate*

- 13.4.1. The assessment of effects on climate will consider the extent to which carbon emissions resulting from the Proposed Scheme may impact the global climate and contribute towards climate change.
- 13.4.2. The study area to be considered for the construction phase will include the embodied carbon of Proposed Scheme materials and emissions associated with construction activities. These are defined in terms of lifecycle stages, as detailed in Section 7 of the PAS 2080:2016 Carbon Management in Infrastructure standard:
- products and materials (A1-A3) – use of materials for temporary and permanent construction activities
  - construction / installation processes (A5) – construction plant use
- 13.4.3. The study area to be considered for the operational phase will include the operational energy requirements of the Proposed Scheme (i.e. road lighting), and the Affected Road Network (ARN) for end-user carbon (vehicle emissions). Assessment of end-user carbon will be undertaken in line with DMRB Volume 11, Section 3, Part 1, LA 105. These elements are defined in terms of life cycle stages, as detailed in Section 7 of PAS 2080:2016 and as follows:
- operational energy use (B6) – operational energy
  - user utilisation of infrastructure (B9) – end-user traffic flows

#### *Vulnerability of the proposed scheme to climate change*

- 13.4.4. For the purposes of the climate change vulnerability assessment, the study area is considered to be the physical infrastructure assets associated with the Proposed Scheme. The Proposed Scheme lifetime is taken to be 60 years in line with TAG and Highways England guidance.
- 13.4.5. The vulnerability assessment will consider climate change effects on the Proposed Scheme assets such as pavements, drainage and geotechnical receptors. In addition, environmental receptors identified within respective disciplines' scope will be considered where climate change has the potential to impact upon them as an in-combination effect.
- 13.4.6. The assessment of vulnerability to climate change will consider construction and operational effects. Climate change effects on construction have the potential to be scoped out depending on the construction duration. The operation

assessment will be informed by the design life of key elements of the Proposed Scheme and availability of UK Climate Projections.

## Survey and desk-based information

### *Effects on climate*

- 13.4.7. The carbon baseline will be taken as the current situation in which no proposed infrastructure is built and considers existing traffic and travel patterns. Potential impacts from emissions associated with the construction and operation of the road infrastructure will be assessed against this baseline.
- 13.4.8. The availability of carbon baseline data specific to the study area is currently limited, therefore existing carbon emissions have been considered from a variety of sources (e.g. published local authority data) in the proximity of the Proposed Scheme.
- 13.4.9. Existing carbon emissions will be considered from a variety of sources in the Local Authority area relevant to the Proposed Scheme (e.g. Norwich City Council and Norfolk County Council), including those from transport infrastructure.
- 13.4.10. In July 2019, Norwich City Council declared a climate emergency. Within their 2040 Vision, they have targeted carbon neutrality by 2050.
- 13.4.11. In 2017, the council reported a carbon footprint of approximately 6,535 tCO<sub>2</sub>e, measured in accordance with national indicator NI185 (Norwich City Council, 2018), although it is noted that this figure reflects emissions specifically associated with the Council's operations (e.g. owned and contractor-operated buildings, vehicle fleet, etc.) rather than the wider local authority region. In 2017, total end-user CO<sub>2</sub> emissions from transport in Norwich were reported as approximately 134,300 tonnes (Department for Business, Energy & Industrial Strategy, 2019).
- 13.4.12. Norfolk County Council reported total emissions for the 2015-16 year to be approximately 99,147 tCO<sub>2</sub>e for Local Authority operations (Norfolk County Council, 2016), and the Council has committed to reducing emissions by 50% by 2020, relative to 2009-10 levels. Most recent figures released for 2017 indicated total transport emissions for the wider Norfolk County area (including all relevant Districts) to be approximately 1,976,200 tCO<sub>2</sub> (Department for Business, Energy & Industrial Strategy, 2019).
- 13.4.13. In 2017, UK net CO<sub>2</sub> emissions were estimated at 373.2 million tonnes (Department for Business, Energy & Industrial Strategy, 2019). Furthermore, 34% of UK carbon emissions in 2017 originated from the transport sector with emissions of 128.7 mtCO<sub>2</sub>e.

### *Vulnerability of the proposed scheme to climate change*

- 13.4.14. A current climate baseline for the wider region has been compiled using Met Office (2016) regional climate data for the Eastern England region. High-level climate observations for the region over a 30-year averaging period (1981-2010) are presented in Table 13.4.

Table 13.4: Historic climate baseline for eastern England

Climate Variables	Climate Observations
Temperature	Mean daily minimum temperatures can range from 0°C to 2°C in winter, whilst summer daily maximum temperatures are in the region of 22°C.
Rainfall	Eastern England includes some of the driest areas in the country, with the majority of the region receiving less than 700 mm of rainfall annually, distributed fairly evenly throughout the year. On average, the region experiences approximately 30 rain days during the winter months (December – February) and under 25 days during the summer period (June – August). Despite generally low levels of precipitation, the area has encountered a number of severe storms which can contribute significantly to total annual rainfall and may also result in the occurrence of hail.
Wind	Eastern England is one of the more sheltered parts of the UK, however the winter months are when the strongest winds are experienced. Wind direction is fairly consistent across the region; speeds are generally greater in coastal locations than inland, and gusts exceeding 167 km/h have been recorded in East Anglia. The frequency of tornadoes is greatest in eastern England relative to other parts of the UK, nevertheless, the intensity of these events remains minor.
Sunshine	Average annual sunshine in the wider region ranges from approximately 1450 hours over Lincolnshire and East Yorkshire, to over 1600 hours in east Norfolk, Suffolk and Essex.
Air Frost	The average number of days with air frost ranges from less than 30 (coastal) to 55 (inland) per year.

Source: Met Office (2016) Regional Climate Data

### *Future projections*

- 13.4.15. The UK Climate Projections (UKCP18) provide regional climate projection information, for which the Proposed Scheme is included within the East of England Administrative Region. The East of England region is predicted to experience changes in temperature, rainfall, and frequency of extreme weather events as a consequence of climate change. These changes are predicted to occur under all emissions scenarios (i.e. low, medium and high levels of greenhouse gas emissions), which are incorporated into the climate change models used by the Inter-governmental Panel on Climate Change (IPCC). The general trend for the region is warmer, drier summers and milder, wetter winters.
- 13.4.16. Under the highest emissions scenario (RCP8.5) projection for the 2080s (2080-2099), estimated changes in climatic conditions are as outlined in Table 13.5.

Table 13.5: Future climate projection data for East of England (2080s; high emissions scenario)

Climate Variables	Climate Projections
Temperature	The average summer temperature is projected to increase by 6-7°C under the central estimate, which represents 'as likely as not' probability of change (50th percentile), and average winter temperature is estimated to increase by 3-4°C (50th percentile).
Rainfall	The average summer rainfall rate is projected to decrease by 30-40%, whereas the average winter rainfall rate is estimated to increase by 20-30% (in the 50th percentile or central estimate for both).
Wind	Climate projections for wind are more uncertain than those for temperature and precipitation, due to inherent difficulty in modelling future wind conditions. However, overall an increase in extreme weather including wind is projected (Committee on Climate Change, 2017).

Source: UKCP18 UK Climate Projections

13.4.17. Climate projection data corresponding to the 2080s (2070-2099) under a high emissions scenario as per NNNPS guidance. That is, transport infrastructure with safety-critical elements and the design life of the asset is 60 years or greater, and therefore applicable to the Proposed Scheme.

## 13.5. Consultation

13.5.1. No external consultation has been undertaken for the assessment at this stage. This will be undertaken, where necessary, as part of the ES.

## 13.6. Scheme considerations

### Potential impacts

13.6.1. Potential impacts related to both carbon emissions and climate change resilience during Proposed Scheme construction and operation are detailed in Table 13.6.

Table 13.6: Potential Impacts

Carbon emissions impact assessment	
Construction	The potential for increased carbon emissions from activities associated with the construction of the Proposed Scheme (capital carbon; e.g. pavement, earthworks) and all associated materials.
Operation	The potential for increased carbon emissions from activities associated with the operation of the Proposed Scheme over the design life (operational carbon; e.g. road lighting). The potential for increased carbon emissions associated with the use of the proposed infrastructure elements (end-user carbon; e.g. 'tailpipe' emissions from road traffic).
Climate change resilience assessment	
Construction	Climate change is not expected to affect Proposed Scheme construction and has been scoped out of the resilience assessment.
Operation	Changes in climate as outlined in Table 13.3 are anticipated over the design life of the Proposed Scheme. This has the potential to pose a risk to Proposed Scheme assets.



## Potential mitigation

### *Effects on climate*

- 13.6.2. In accordance with the DMRB Guidance on Climate (Volume 11, Section 3, Part 14) projects shall seek to minimise carbon emissions as far as possible in all cases in order to contribute to the UK's net reduction in carbon emissions. Mitigation of effects on climate (i.e. carbon emissions associated with the Proposed Scheme) will primarily take place throughout the design process in accordance with the principles of PAS 2080 (Carbon Management in Infrastructure). Details of any mitigation measures relevant to climate will be reported in the subsequent ES.
- 13.6.3. Chapter 4 (Air Quality) and Chapter 9 (Materials), will outline measures to be included in the Construction Environmental Management Plan (CEMP) which will serve to limit carbon emissions. This mitigation could include the following:
- reduction of raw material usage and recycling
  - use of local suppliers
- 13.6.4. Further assessment of the carbon emissions associated with the Proposed Scheme and potential mitigation measures will be reported in the ES.

### *Vulnerability of the proposed scheme to climate change*

- 13.6.5. The Proposed Scheme may be subject to weather extremes during construction, although it is not anticipated that quantifiable climate change will occur in the timeline between the time of design and environmental assessment, and the end of the construction period. Construction works are thus not considered to be vulnerable to climate change, therefore no associated mitigation, other than what will be reasonable site practice at the time of design finalisation, is considered to be necessary.
- 13.6.6. Operational climate mitigation measures will be outlined within the ES.

## 13.7. Summary

- 13.7.1. The Proposed Scheme has the potential to generate an increase in carbon emissions during both construction and operation. Changes in climate have the potential to impact Proposed Scheme assets and environmental receptors during operation.
- 13.7.2. Further work will be undertaken to develop design interventions to limit or reduce adverse impacts. Any design development and potential mitigation will be reported in the ES as well as further detailing of baseline conditions and climate emissions resilience.



## 14. Combined and cumulative impacts

### 14.1. Introduction

14.1.1. Combined and cumulative impacts result from multiple actions on receptors over time and are generally additive or interactive (synergistic) in nature. They can also be considered as effects resulting from incremental changes caused by other past, present or reasonably foreseeable actions together with the project, identified as:

- combined effects from a single project (the interrelationship between different environmental factors)
- cumulative effects from different projects (with the project being assessed)

### 14.2. Study area Combined impacts

14.2.1. The study area for the assessment of combined impacts, for both construction and operation, are defined by the study areas identified within the relevant environment topic chapters of this Preliminary Environmental Information Report (PEIR).

#### Cumulative

14.2.2. The search area for the identification of 'other developments' for inclusion in the assessment of cumulative effects will reflect a 2km Zone of Influence (ZOI) around the boundary of the Proposed Scheme, for both construction and operation. This 2km ZOI is large enough to cover the proposed developments likely to contribute to cumulative impacts, whilst being proportionate to the scope and scale of the Proposed Scheme. DMRB (Volume 11, Section 2, Part 4) LA 104 "Environmental assessment and monitoring" details the study area for the assessment of cumulative impacts should be defined on a case-by-case basis reflecting the Proposed Scheme in question and the area over which impacts can reasonably be considered to have the potential to occur from both the Proposed Scheme and in combination with other developments therefore a 2km search area is deemed appropriate for the Proposed Scheme.

### 14.3. Combined and cumulative impacts

14.3.1. The likely residual impacts and proposed mitigation for combined cross-discipline impacts and potential cumulative impacted from other developments will be identified and incorporated into the cumulative impact's assessment of the ES.

## **14.4. Summary**

- 14.4.1. The chapter of the ES will bring together the principal findings of each topic chapters in order to identify and assess the combined and cumulative impacts of the Proposed Scheme in association with other existing or future developments within the study area.

## 15. Glossary and references

Acronym	Description
<b>AADT</b>	Annual Average Daily Traffic
<b>ALC</b>	Agricultural Land Classification
<b>AOD</b>	above ordnance datum
<b>AONB</b>	Area of Outstanding Natural Beauty
<b>AQIA</b>	Air quality impact assessment
<b>AQMA</b>	Air Quality Management Area
<b>AQO</b>	Air Quality Objectives
<b>ARN</b>	Affected Road Network
<b>BAP</b>	Biodiversity Action Plan
<b>BGS</b>	British Geological Survey
<b>BMV</b>	Best and Most Versatile Land
<b>BoCC</b>	Birds of Conservation Concern
<b>BS</b>	British Standard
<b>c.</b>	circa
<b>CCI</b>	Community Conservation Index
<b>CEMP</b>	Construction Environmental Mitigation Plan
<b>CIRIA</b>	Construction Industry Research and Information Association
<b>CL:AIRE</b>	Contaminated Land: Applications in Real Environments
<b>CO<sub>2</sub></b>	Carbon Dioxide
<b>CRTN</b>	Calculation of Road Traffic Noise
<b>CWS</b>	County Wildlife Site
<b>CZ</b>	Consultation Zone
<b>DAFOR</b>	Scale: Dominant, Abundant, Frequent, Occasional, Rare
<b>DCLG</b>	(former) Department for Communities and Local Government
<b>DCO</b>	Development Consent Order
<b>DEFRA</b>	Department for the Environment, Food and Rural Affairs
<b>dB</b>	Decibel
<b>DfT</b>	Department for Transport

Acronym	Description
<b>DMRB</b>	Design Manual for Roads and Bridges
<b>DMV</b>	Deserted Medieval Village
<b>EAR</b>	Environmental Assessment Report
<b>EcIA</b>	Ecological Impact Assessment
<b>ECOW</b>	Ecological Clerk of Works
<b>eDNA</b>	Environmental DNA
<b>EIA</b>	Environmental Impact Assessment
<b>ES</b>	Environmental Statement
<b>EU</b>	European Union
<b>GCN</b>	Great Crested Newt
<b>GHG</b>	Greenhouse Gas
<b>GI</b>	Ground Investigation
<b>GIS</b>	Geographic Information System
<b>GP</b>	General Practitioner
<b>GPA</b>	Good Practice Advice
<b>GVA</b>	Gross Value Added
<b>HADDMS</b>	Highways Agency Drainage Data Management System
<b>HDV</b>	Heavy Duty Vehicle
<b>HAGDMS</b>	HAGDMS – Highways Agency Geotechnical Data Management System
<b>HER</b>	Historic Environment Records
<b>HGV</b>	Heavy Goods Vehicle
<b>HRA</b>	Habitats Regulations Assessment
<b>HSI</b>	Habitat Suitability Index
<b>IAN</b>	Interim Advice Note
<b>IT</b>	Interim Target
<b>Km</b>	kilometre
<b>Kph</b>	Kilometres per hour
<b>LED</b>	Light Emitting Diode
<b>LCA</b>	Landscape Character Areas

Acronym	Description
<b>LIA</b>	Local Impact Area
<b>LLFA</b>	Lead Local Flood Authority
<b>LNR</b>	Local Nature Reserve
<b>LSOA</b>	Lower Super Output Area
<b>LUC</b>	Land Use Consultants
<b>LVIA</b>	Landscape and Visual Impact Assessment
<b>LWS</b>	Local Wildlife Site
<b>m</b>	metre
<b>MHCLG</b>	<i>(former)</i> Ministry of Housing, Communities and Local Government
<b>MMP</b>	Materials Management Plan
<b>MPI</b>	Major Projects Instruction
<b>MT</b>	Motorised Travellers
<b>MtCO<sub>2e</sub></b>	Metric tons of carbon dioxide equivalent
<b>NBIS</b>	Norfolk Biodiversity Information Service
<b>NCA</b>	National Character Area
<b>NERC</b>	Natural Environment and Rural Communities
<b>NHLE</b>	National Heritage List for England
<b>NIA</b>	Noise Important Area
<b>WCH</b>	Walkers, Cyclists and Horse Riders
<b>NNR</b>	National Nature Reserves
<b>NNNPS</b>	National Networks National Policy Statement
<b>NO<sub>2</sub></b>	Nitrogen dioxide
<b>NO<sub>x</sub></b>	Nitrogen Oxides
<b>NSIP</b>	Nationally Significant Infrastructure Project
<b>NVZ</b>	Nitrate Vulnerable Zone
<b>ONS</b>	Office for National Statistic
<b>OS</b>	Ordnance Survey
<b>PA</b>	Planning Act
<b>PAS</b>	Publically Available Specification

Acronym	Description
<b>PCM</b>	Pollution Climate Mapping
<b>PEI</b>	Preliminary Environmental Information
<b>PEIR</b>	Preliminary Environmental Information Report
<b>PIE</b>	Public Information Event
<b>PINS</b>	The Planning Inspectorate
<b>PPE</b>	Personal Protective Equipment
<b>PRF</b>	Preliminary Roost Feature
<b>PRoW</b>	Public Right of Way
<b>RBMP</b>	River Basin Management Plan
<b>RIS</b>	Road Investment Strategy
<b>RNR</b>	Roadside Nature Reserve
<b>RSPB</b>	Royal Society for the Protection of Birds
<b>SAC</b>	Special Area of Conservation
<b>SEB</b>	Statutory Environmental Bodies
<b>SoCC</b>	Statement of Community Consultation
<b>SPA</b>	Special Protected Area
<b>SSSI</b>	Site of Special Scientific Interest
<b>SuDS</b>	sustainable urban drainage systems
<b>TAG</b>	Transport Analysis Guidance
<b>TEAM</b>	Transparent Economic Assessment Model
<b>TMP</b>	Traffic Management Plan
<b>µg/m<sub>3</sub></b>	Microgram per metre cubed
<b>UK</b>	United Kingdom
<b>UKCP</b>	United Kingdom Climate Projections
<b>VP</b>	Vantage Point
<b>WFD</b>	Water Framework Directive
<b>WHO</b>	World Health Organization
<b>WIA</b>	Wider Impact Area
<b>ZOI</b>	Zone of Influence

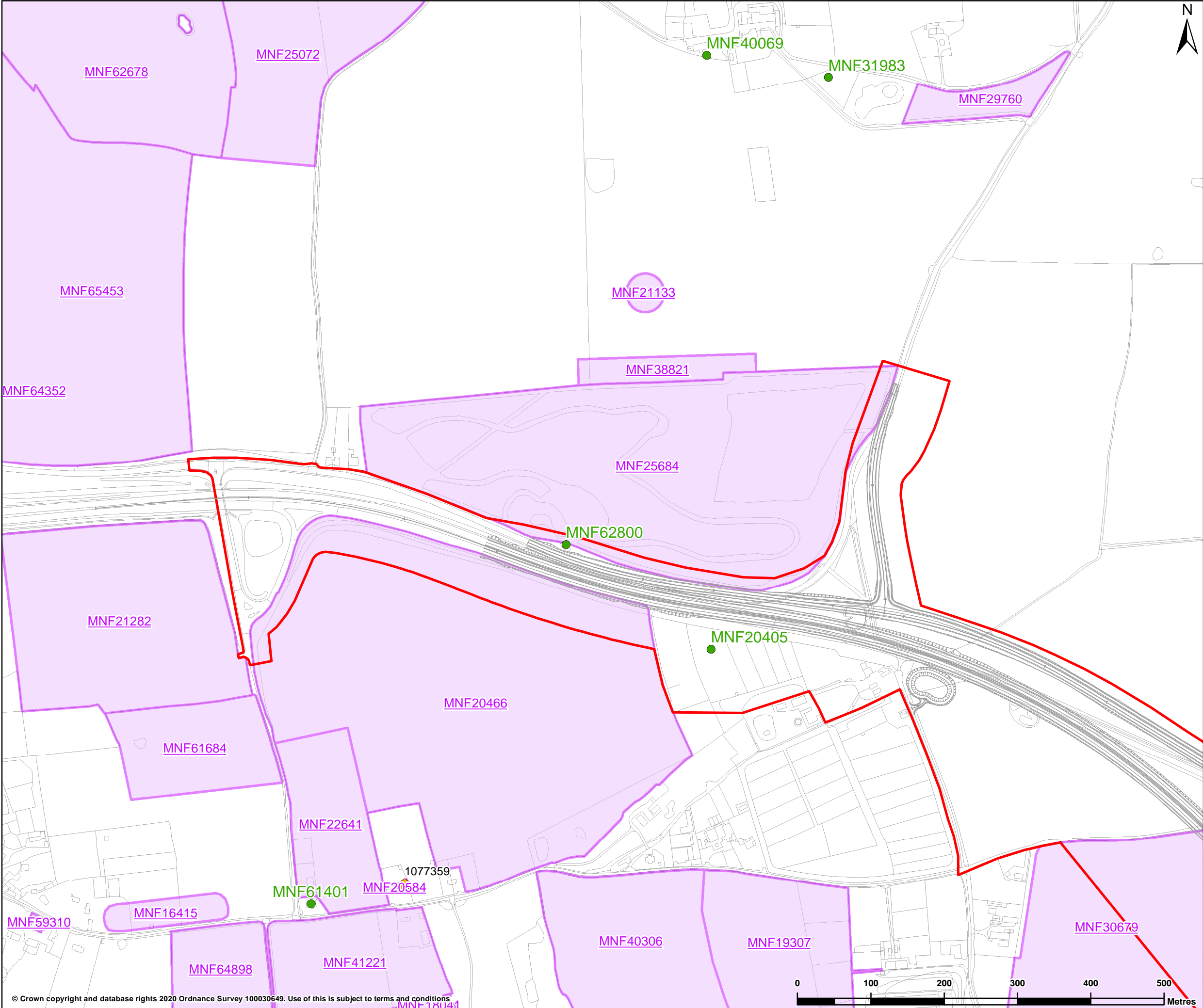
Acronym	Description
<b>Definitions</b>	
Term	Description
Air quality limit value	A level fixed on the basis of scientific knowledge, with the aim of avoiding, preventing or reducing harmful effects on human health and/or the environment as a whole, to be attained within a given period.
Air Quality Management Area	An area identified by a local authority where the local air quality objectives not being achieved or are not likely to be achieved within the relevant period. As required by Part IV of the Environment Act 1995.
Air quality objectives	Ambient concentration not to be exceeded, either without exception or with a permitted number of exceedances, within a specified timescale
Air Quality Strategy	The Government's air quality policy document for England, Scotland, Wales and Northern Ireland
Ambient concentration	Concentration of a pollutant in the surrounding area of environment
Artefact	An item of archaeological interest
Averaging period	A period of time over which a concentration is averaged when reporting air quality statistics. Commonly used averaging periods are 1-hour, 24-hour, 30-days and 365-days (annual). The averaging periods available for use is determined by the measurement technique employed for a given pollutant.
A-weighting	A standard filter applied to acoustic pressure fluctuations to compensate for the relatively low sensitivity of human ears to low and high frequencies
Bronze Age	The period of human activity between 2,500 BC and 700 BC
Continuous monitoring	The measurement of a pollutant concentration using an electronic instrumentation continuously over time. The time interval for each measurement is very short which allows rapid changes to be recorded. These measurements can be aggregated in to longer period averages of 1-hour, 8-hour etc.
Cutting	The removal of soil or rock material to reduce the profile or elevation of the topography of a site.
Data capture rate	The quantity of actual data collected over a specified period as a percentage of the theoretical maximum available
Diffusion tube	Simple monitoring device for air pollutants that absorbs substances from the air by diffusion (e.g. nitrogen dioxide) into a liquid film coated onto the inside of a plastic tube.
dB	A logarithmic scale that is used for sound pressure levels. Typically, a quiet night-time level in a bedroom is 30dB and 90dB is the level at the kerbside of a busy road
Earthworks	The moving of soil or rock to reconfigure the topography of a site.
Embodied Carbon	The amount of carbon released from material extraction, transport, manufacturing and related activities. This may be calculated from cradle to (factory) gate, cradle to (installation) site or from cradle to grave (final point of disposal).
Exceedance	Infringement environmental protection standards by exceeding allowable limits or concentration levels.
Fieldwalking survey	Method of systematic non-intrusive survey involving walking across a plough field along transects to collect archaeological artefacts

Acronym	Description
Geophysical survey	Method of non-intrusive investigation involving the use of magnetometers to identify fluctuations in the earth's magnetic field which might indicate the presence of archaeological remains. Burnt remains and metals are best identified through this method of survey.
Heritage asset	An item of heritage interest, for example an historic building or an archaeological find.
Iron Age	The period of human activity between 700 BC and 43 AD
LA10,18h	The A-weighted sound level in dB that is exceeded 10% of the measurement period and is the standard index used within the UK to describe daytime traffic noise
LAeq,T	The A-weighted steady sound level over time interval T that has the same mean square pressure as the time varying noise over the same time interval
LiDAR	Light Detection and Ranging. A remote sensing operation using data taken from the air to identify changes in the landform.
Lnight	The equivalent continuous sound level which has the same A-weighted mean square pressure as the time varying noise between 23:00 and 07:00
Made Ground	Ground created by infilling an area with material taken from elsewhere; typically, reworked soils, rubble, gravel, sand or former waste material e.g. ash.
MMP (Materials Management Plan)	MMP - Materials Management Plan; The MMP documents how all of the materials to be excavated are to be dealt with.
Medieval	The period of human activity between 1066 AD and 1550 AD
Mesolithic	Middle Stone Age. The period of human activity between 10,000 BC and 4,500 BC.
Metal detector survey	Method of intrusive investigation involving the use of metal detectors to locate buried metal objects.
Modern	The period of human activity from 1900 to the present day
National Mapping Programme (NMP)	A project funded by Historic England and local councils involving assessment and interpretation of aerial photographs and other remote sensing data, such as LiDAR.
Neolithic	New Stone Age. The period of human activity between 4,500 BC and 2,500 BC
NERC S41	Section 41 of the Natural Environment and Rural Communities Act 2006
Nitrogen oxides (NOx)	Nitrogen oxides is a term used to describe a mixture of nitric oxide (NO) and nitrogen dioxide (NO <sub>2</sub> ), referred to collectively as NOx. These are primarily formed from atmospheric and fuel nitrogen as a result of high temperature combustion. The most important sources in the UK are road traffic and power generation
Palaeolithic	Old Stone Age. The period of human activity before around 10,000 BC
Post-medieval	The period of human activity between 1550 AD and 1900 AD
PM <sub>10</sub>	Particulate Matter less than 10 microns, tiny solid or liquid particles of soot, dust, smoke, fumes, and aerosols. The size of the particles (10 microns or smaller, about 0.0004 inches or less) allows them to easily enter the air sacs in the lungs where they may be deposited, resulting in adverse health effects
Prehistoric	The period before the year 43 AD



Acronym	Description
Roman	The period of human activity between 43 AD and 410 AD
Saxon	The period of human activity between 410 AD and 1066 AD
SRP	Soil Resource Plan; part of the Code of Practice for the Sustainable Use of Soils on Construction Sites used to protect soils and ensure adequate soil function (e.g. plant growth, water attenuation, biodiversity) during and after construction.
Site Waste Management Plan (SWMP)	A plan which specifies how waste generated throughout the construction works will be managed and volumes estimated. This includes minimisation, storage, segregation, re-use and final disposal of wastes generated.

## 16. Associated figures



LEGEND

- Proposed scheme layout
- Scoping boundary
- Grade II - Listed buildings
- Heritage locations
- Heritage areas

MNF12345 = Monument unique ID

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REFERENCE MAP

P01	11/02/2020	First Edition	AC	PB	BA
REV	DATE	REVISION NOTE	ORG	CHK'D	APP'D

DESIGNER

**SWECO**

CONTRACTOR

**GallifordTry**

CLIENT

**highways  
england**

PROJECT TITLE

A47 NORTH TUDDENHAM TO EASTON

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 5.1:  
CULTURAL HERITAGE ASSETS  
SHEET 1 OF 6

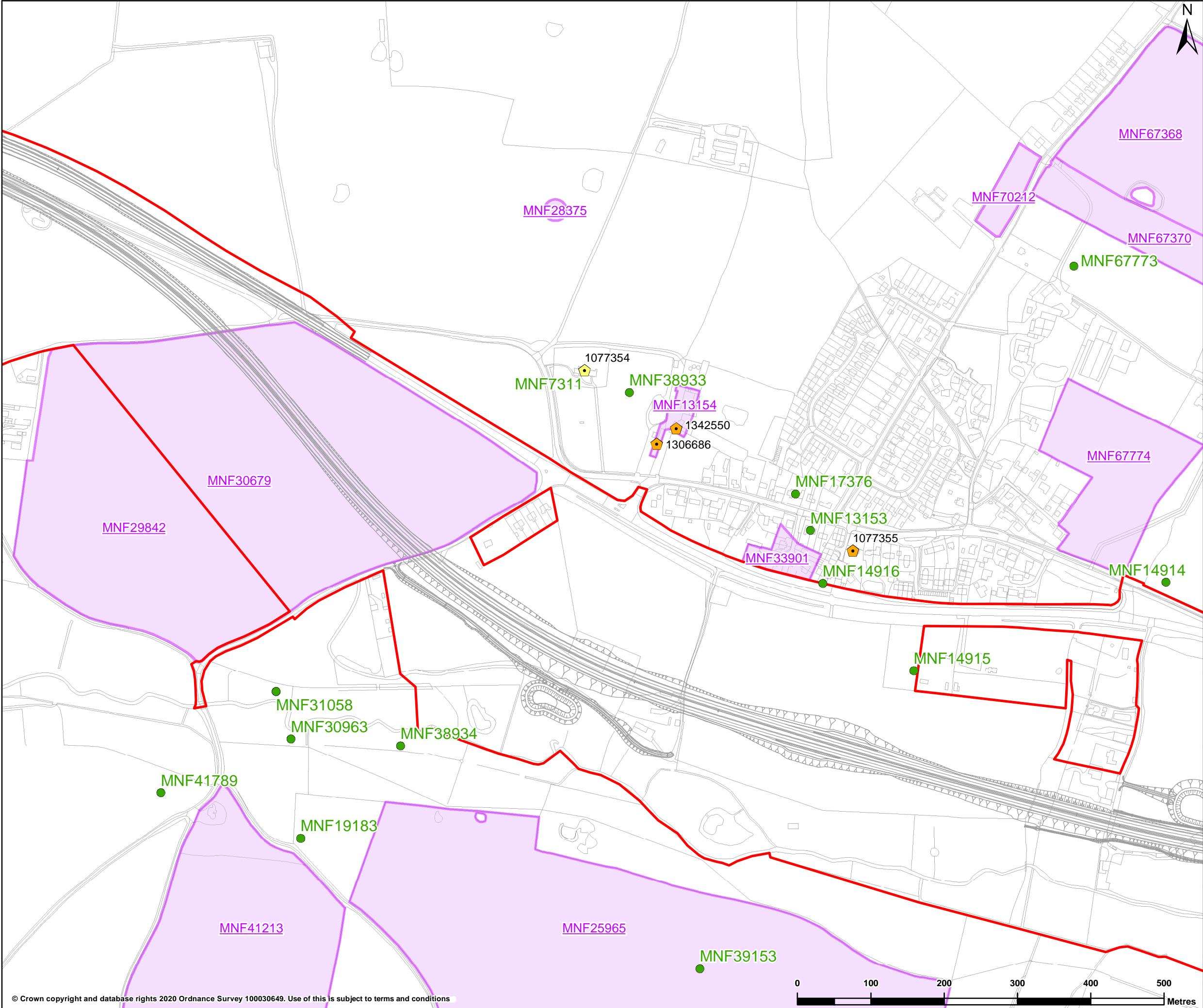
SUITABILITY

FOR INFORMATION

SHEET SIZE	A3	SCALE	1:5,000	STATUS	S0
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DRAWING NUMBER

HE551489-GTY-EGN-000-DR-LX-30012



LEGEND

- Proposed scheme layout
- Scoping boundary
- Grade I - Listed buildings
- Grade II - Listed buildings
- Heritage locations
- Heritage areas

MNF12345 = Monument unique ID

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REFERENCE MAP

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DESIGNER

**SWECO**

CONTRACTOR

**GallifordTry**

CLIENT

**highways  
england**

PROJECT TITLE

A47 NORTH TUDDENHAM TO EASTON

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 5.1:  
CULTURAL HERITAGE ASSETS  
SHEET 2 OF 6

SUITABILITY

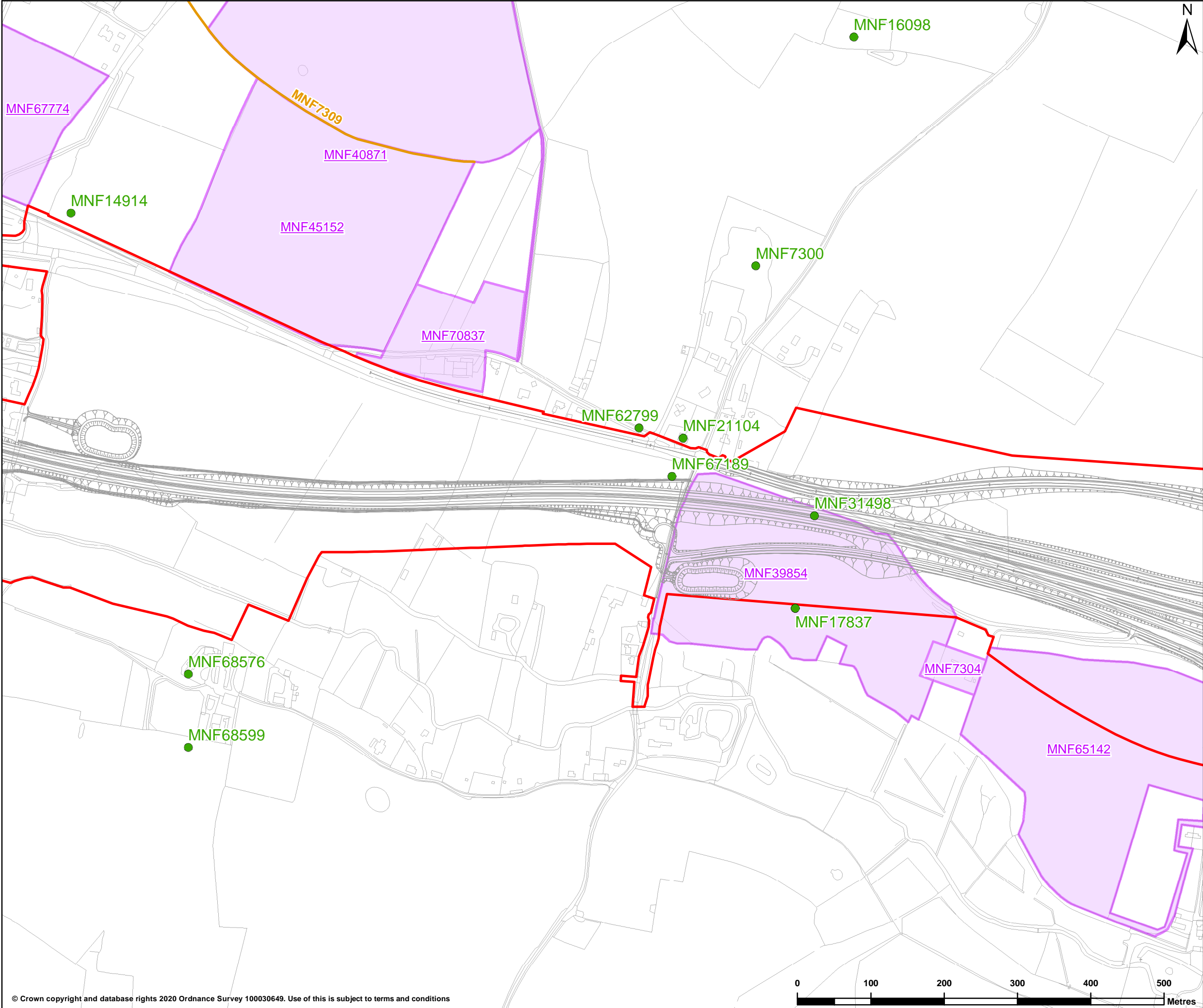
FOR INFORMATION

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A3	1:5,000	S0

DRAWING NUMBER

HE551489-GTY-EGN-000-DR-LX-30013





LEGEND

—

Proposed scheme layout

Scoping boundary

●

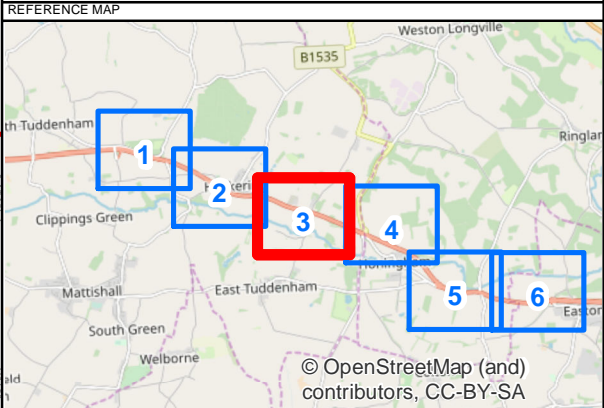
Heritage locations

Heritage - linear feature

Heritage areas

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PROJECT TITLE

A47 NORTH TUDDENHAM TO EASTON

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 5.1:  
CULTURAL HERITAGE ASSETS  
SHEET 3 OF 6

SUITABILITY

FOR INFORMATION

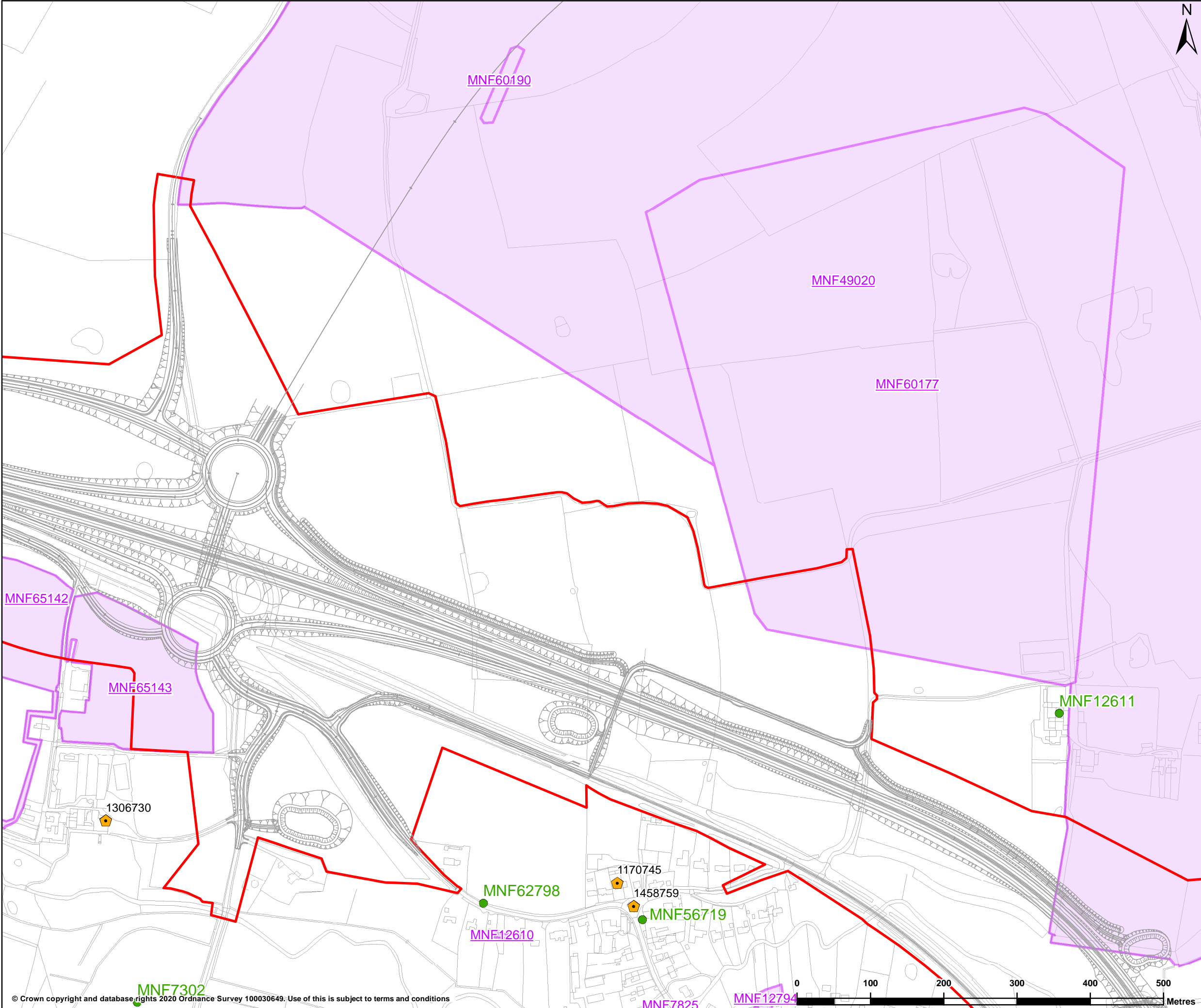
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LEGEND

- Proposed scheme layout
- Scoping boundary
- Grade II - Listed buildings
- Heritage locations
- Heritage areas

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REFERENCE MAP

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PROJECT TITLE

A47 NORTH TUDDENHAM TO EASTON

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 5.1:  
CULTURAL HERITAGE ASSETS  
SHEET 4 OF 6

SUITABILITY

FOR INFORMATION

SHEET SIZE	A3	SCALE	1:5,000	STATUS	S0
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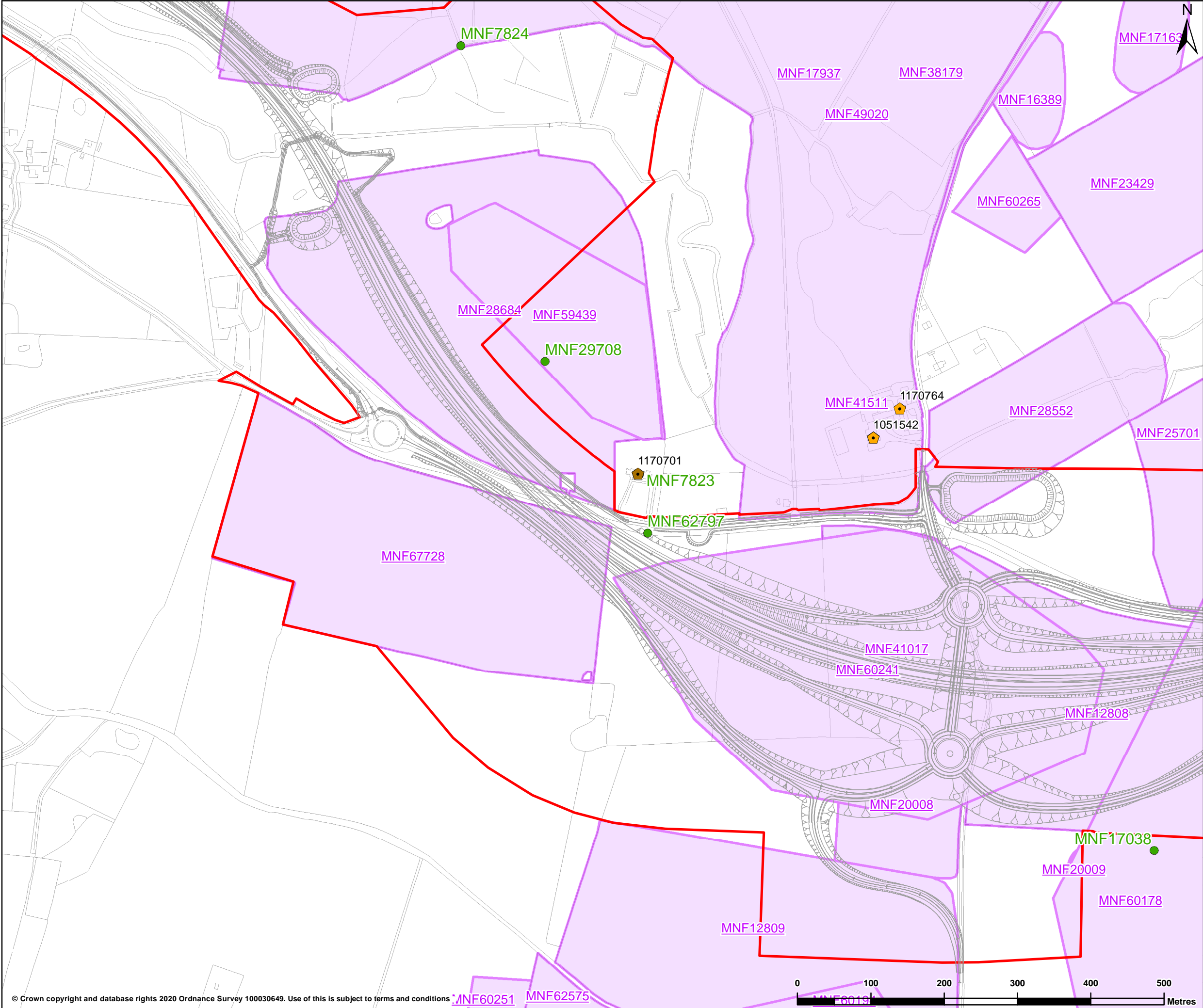
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LEGEND

- Proposed scheme layout
- Scoping boundary
- Grade II - Listed buildings
- Grade II\* - Listed bulidings
- Heritage locations
- Heritage areas

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PROJECT TITLE

A47 NORTH TUDDENHAM TO EASTON

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 5.1:  
CULTURAL HERSETS  
SHEET 5 OF 6

SUITABILITY

FOR INFORMATION

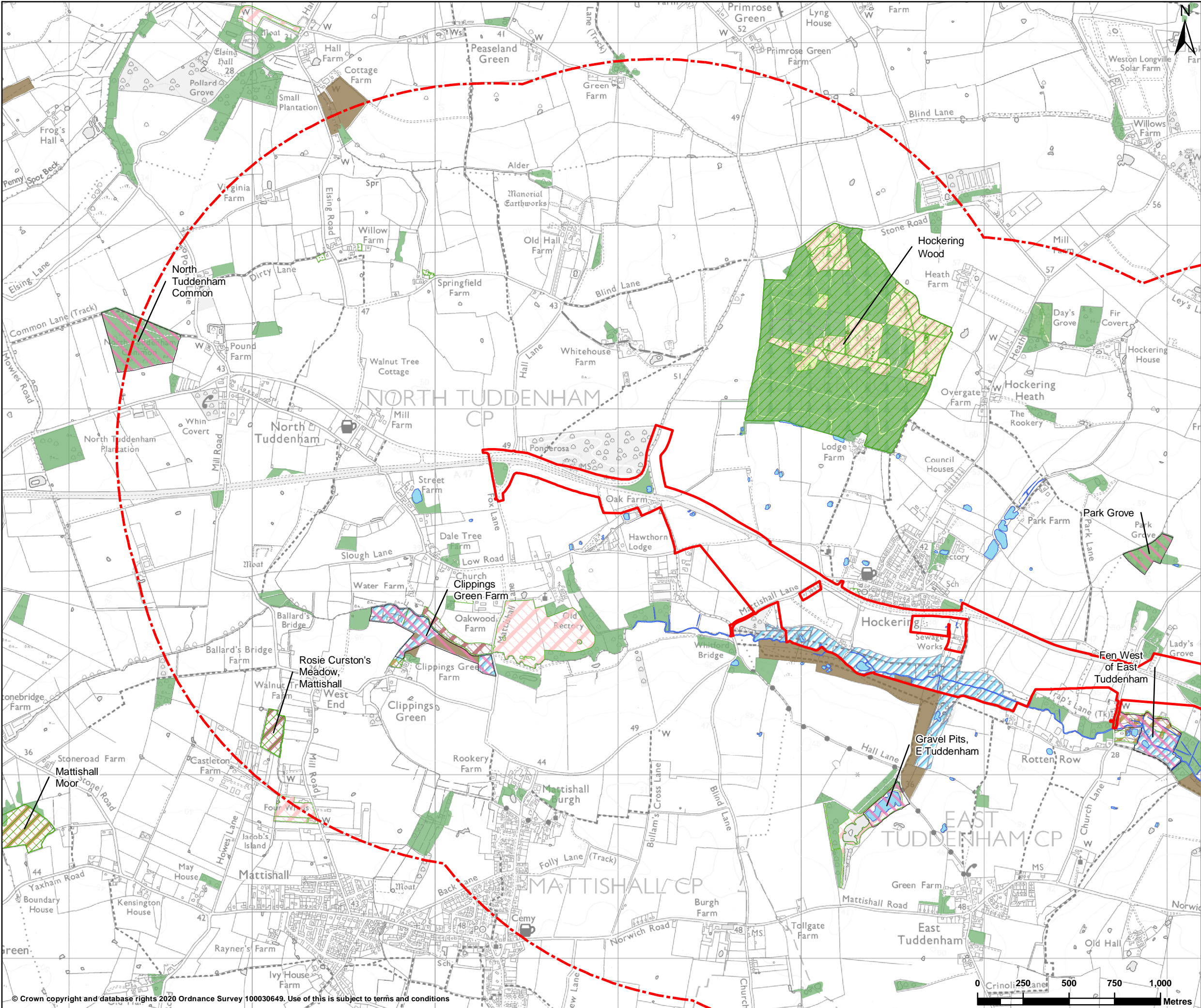
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DRAWING NUMBER

HE551489-GTY-EGN-000-DR-LX-30016







Scoping boundary

Scoping boundary - 2km buffer

Waterbody

Statutory designated sites

Site of special scientific interest

Non - statutory designated sites

County wildlife site

Priority habitat

Coastal and floodplain grazing marsh

Deciduous woodland

Good quality semi-improved grassland

Lowland fens

Lowland meadows

No priority habitat but additional habitats present

Traditional orchard

Ancient & Semi-Natural Woodland

Ancient Replanted Woodland

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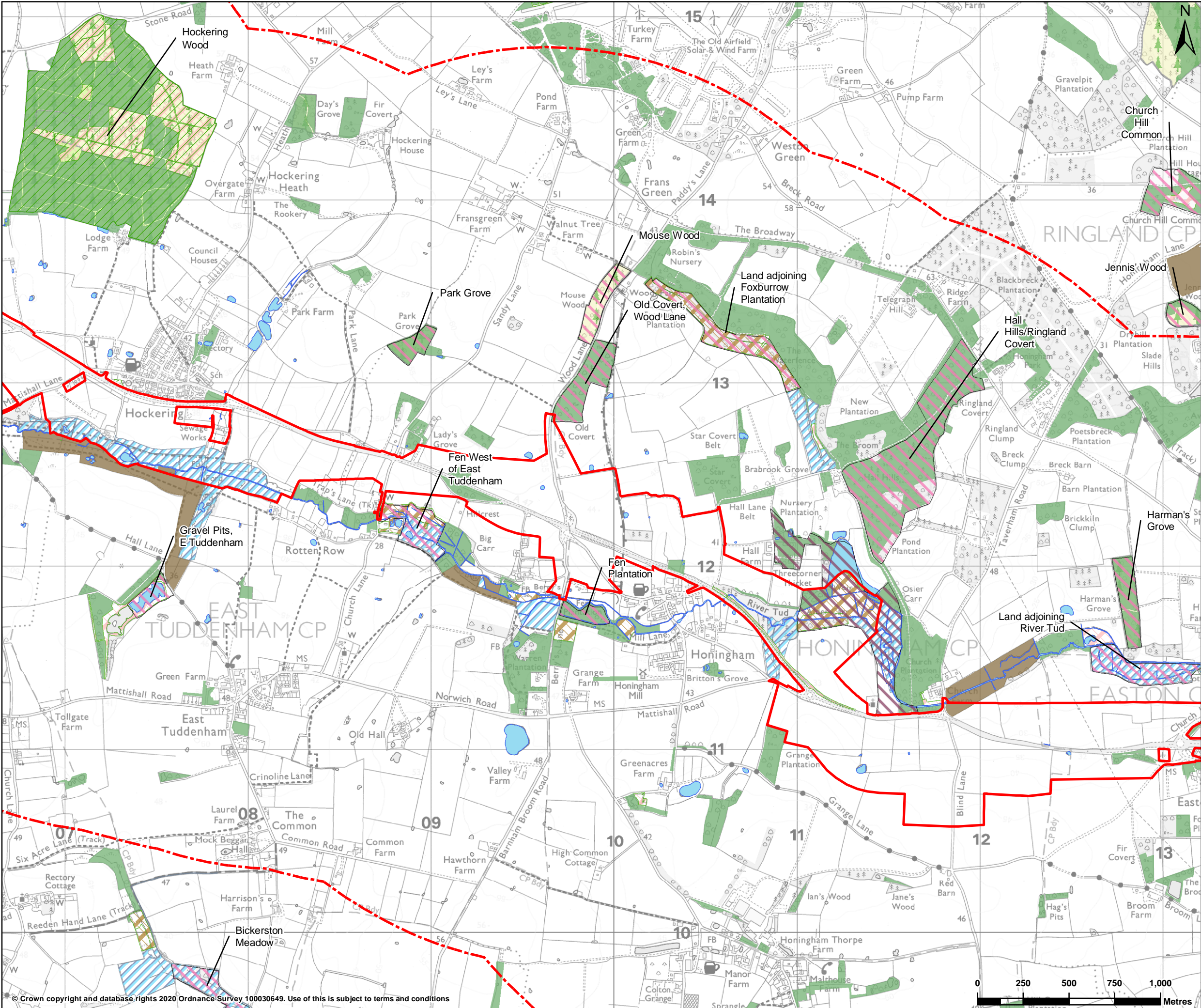
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CLIENT									
PROJECT TITLE									
A47 NORTH TUDDENHAM TO EASTON									
PROJECT STAGE									
PCF STAGE 3									
DRAWING TITLE									
FIGURE 7.1: DESIGNATED SITES AND PRIORITY HABITATS SHEET 1 OF 3									
SUITABILITY									
FOR INFORMATION									
SHEET SIZE		SCALE		STATUS					
A3		1:20,000		S0					
DRAWING NUMBER									
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Scoping boundary

Scoping boundary - 2km buffer

Waterbody

Statutory designated sites

Site of special scientific interest

Non - statutory designated sites

County wildlife site

Proposed county wildlife site

Priority habitat

Coastal and floodplain grazing marsh

Deciduous woodland

Good quality semi-improved grassland

Lowland fens

No priority habitat but additional habitats present

Traditional orchard

Ancient & Semi-Natural Woodland

Ancient Replanted Woodland

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SWECO

GallifordTry

CLIENT

highways  
england

PROJECT TITLE

A47 NORTH TUDDENHAM TO EASTON

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 7.1:  
DESIGNATED SITES AND PRIORITY HABITATS  
SHEET 2 OF 3

SUITABILITY

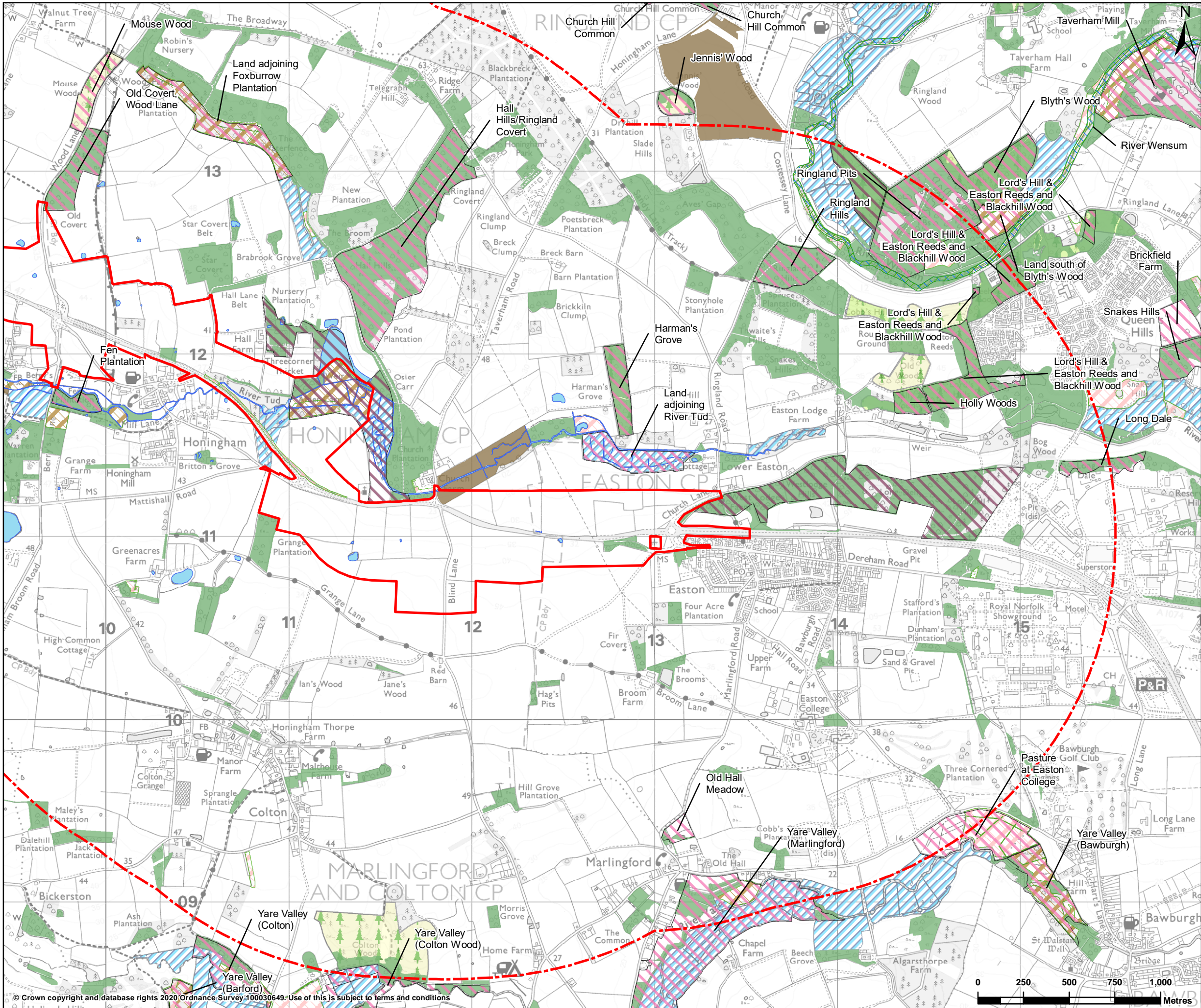
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DRAWING NUMBER

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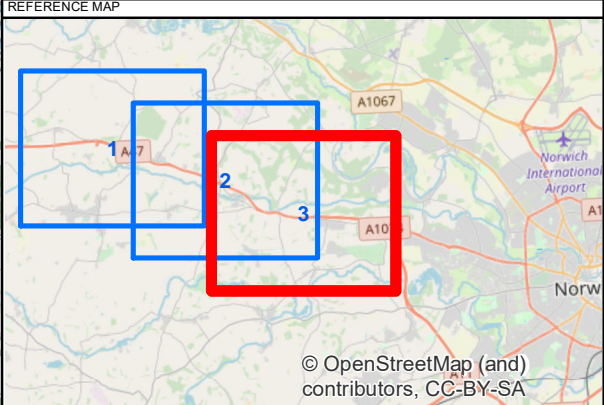







**LEGEND**

- Scoping boundary
- Scoping boundary - 2km buffer
- Waterbody
- Statutory designated sites**
  - Site of special scientific interest
  - Special area of conservation
- Non - statutory designated sites**
  - County wildlife site
  - Proposed county wildlife site
- Priority habitat**
  - Coastal and floodplain grazing marsh
  - Deciduous woodland
  - Good quality semi-improved grassland
  - Lowland fens
  - No priority habitat but additional habitats present
  - Traditional orchard
  - Ancient & Semi-Natural Woodland
  - Ancient Replanted Woodland

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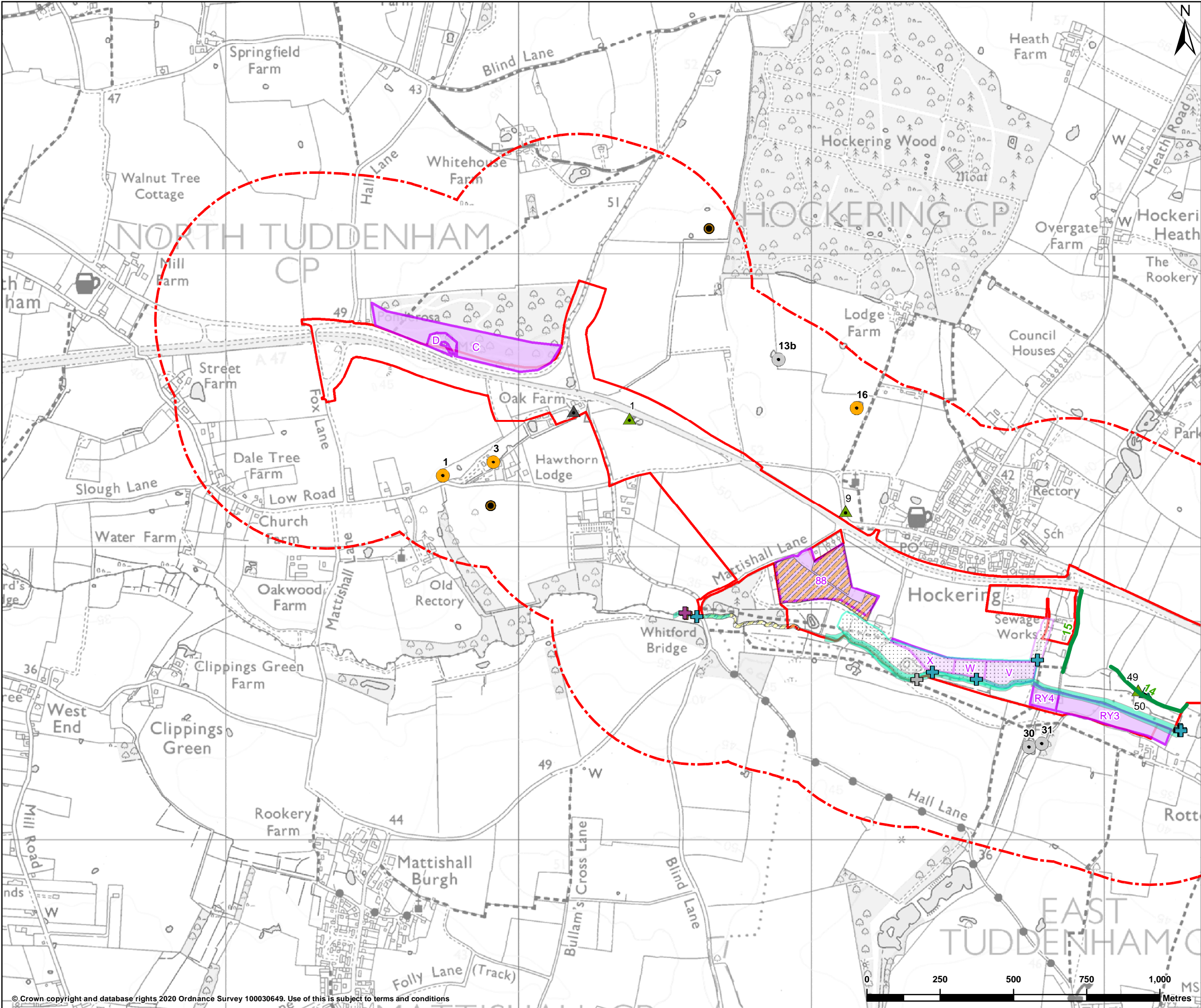


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CONTRACTOR					
GallifordTry 					
CLIENT					
 highways england					
PROJECT TITLE					
A47 NORTH TUDDENHAM TO EASTON					
PROJECT STAGE					
PCF STAGE 3					
DRAWING TITLE					
FIGURE 7.1 DESIGNATED SITES AND PRIORITY HABITATS SHEET 3 OF 3					
SUITABILITY					
FOR INFORMATION					
SHEET SIZE		SCALE		STATUS	
A3		1:20,000		S0	
DRAWING NUMBER					
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**LEGEND**

Scoping boundary  
Scoping boundary - 500m buffer  
Potentially important hedgerows  
Otter Survey  
Feeding remains  
Otter Slide  
Otter Spraint  
Potential Holt  
Type  
Brown Hare  
Bat roost  
Building  
Tree  
Standing dead wood  
Great Crested Newt presence  
Small populations present (0-10 Great Crested Newts recorded)  
eDNA positive but no population recorded  
Waterside present  
Invertebrates areas  
High potential for terrestrial invertebrates  
White-clawed Crayfish present  
Precautionary reptile mitigation areas  
Common amphibian populations present  
Precautionary reptile mitigation areas  
Botanical interest areas

**REFERENCE MAP**

P01	30/01/2020	First Edition	AC	DW	FB
REV	DATE	REVISION NOTE	ORG	CHKD	APPD

DESIGNER

**SWECO**

CONTRACTOR

**GallifordTry**

CLIENT

**highways  
england**

PROJECT TITLE

A47 NORTH TUDDENHAM TO EASTON

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 7.2:  
ECOLOGICAL CONSTRAINTS PLAN  
SHEET 1 OF 3

SUITABILITY

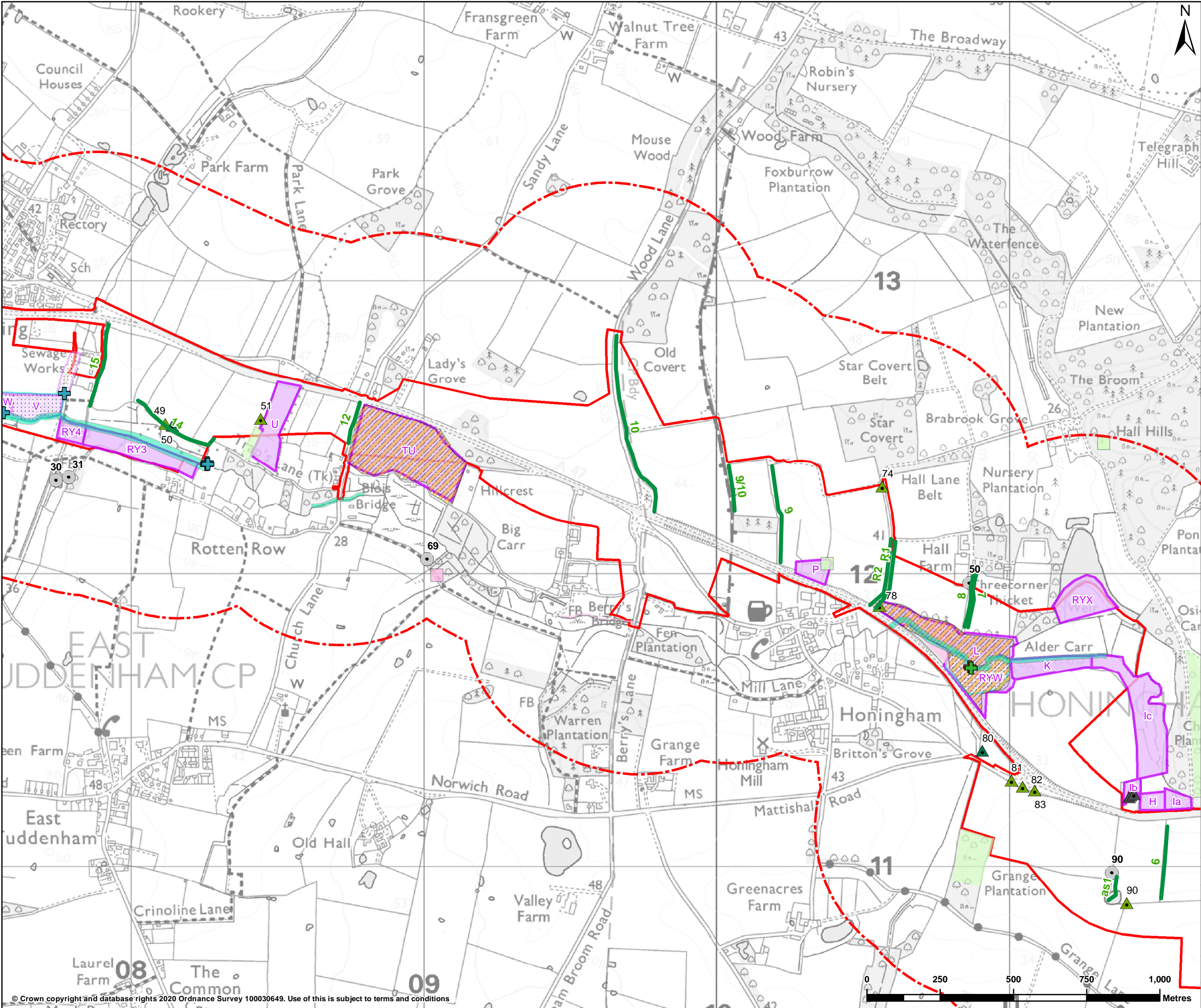
FOR INFORMATION

SHEET SIZE	A3	SCALE	1:12,500	STATUS	S0
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DRAWING NUMBER

HE551489-GTY-EGN-000-DR-LX-30021





Scoping boundary

Scoping boundary - 500m buffer

Potentially important hedgerows

Otter Survey

Partial footprint

Otter Slide

Otter Spraint

Bat roost

Building

Tree

Standing dead wood

Great Crested Newt presence

eDNA positive but no population recorded

Water vole present

Invertebrates areas

High potential for terrestrial invertebrates

Invasive species locations

Himalayan balsam

Rhododendron

Invasive species areas

Himalayan balsam

Rhododendron

Precautionary reptile mitigation areas

Common amphibian populations present

Precautionary reptile mitigation areas

Botanical interest areas

REFERENCE MAP

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CONTRACTOR

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PROJECT TITLE

A47 NORTH TUDDENHAM TO EASTON

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 7.2:  
ECOLOGICAL CONSTRAINTS PLAN  
SHEET 2 OF 3

SUITABILITY

FOR INFORMATION

SHEET SIZE	A3	SCALE	1:12,500	STATUS	S0
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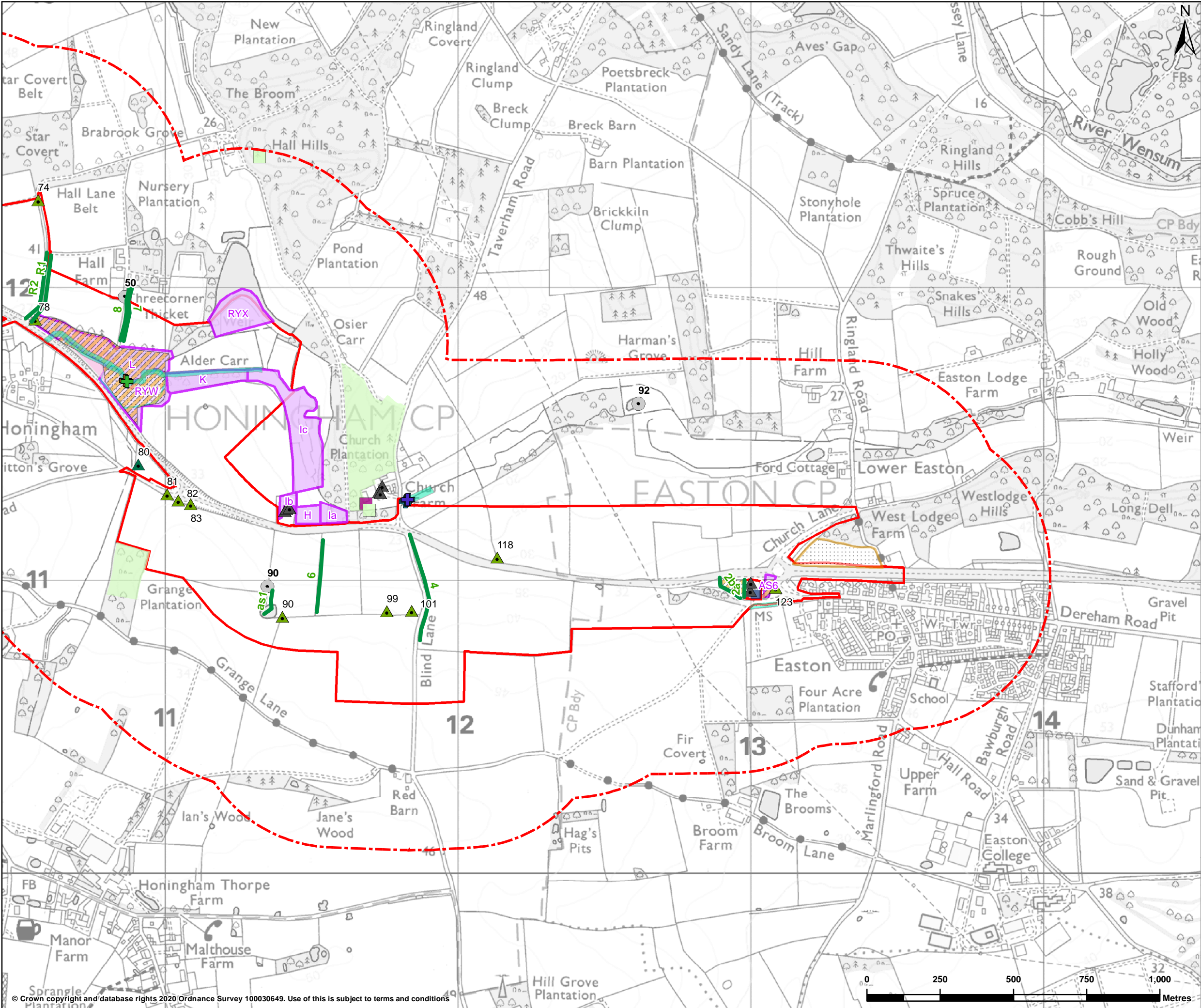
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**LEGEND**

- Scoping boundary
- Scoping boundary - 500m buffer
- Potentially important hedgerows
- Otter Survey
  - Partial footprint
  - Otter Slide
  - Otter Spraint
  - Otter anal jelly
- Bat roost
- Building
- Tree
- Standing dead wood
- Great Crested Newt presence
  - eDNA positive but no population recorded
- Water vole present
- Invertebrates areas
  - High potential for terrestrial invertebrates
- Invasive species locations (Individual recordings)
  - Cotoneaster sp.
  - Himalayan balsam
  - Rhododendron
- Invasive species areas
  - Himalayan balsam
  - Rhododendron
  - Spanish bluebells
- Precautionary reptile mitigation areas
  - Precautionary reptile mitigation areas
  - Slow worm and grass snake populations present
  - Botanical interest areas

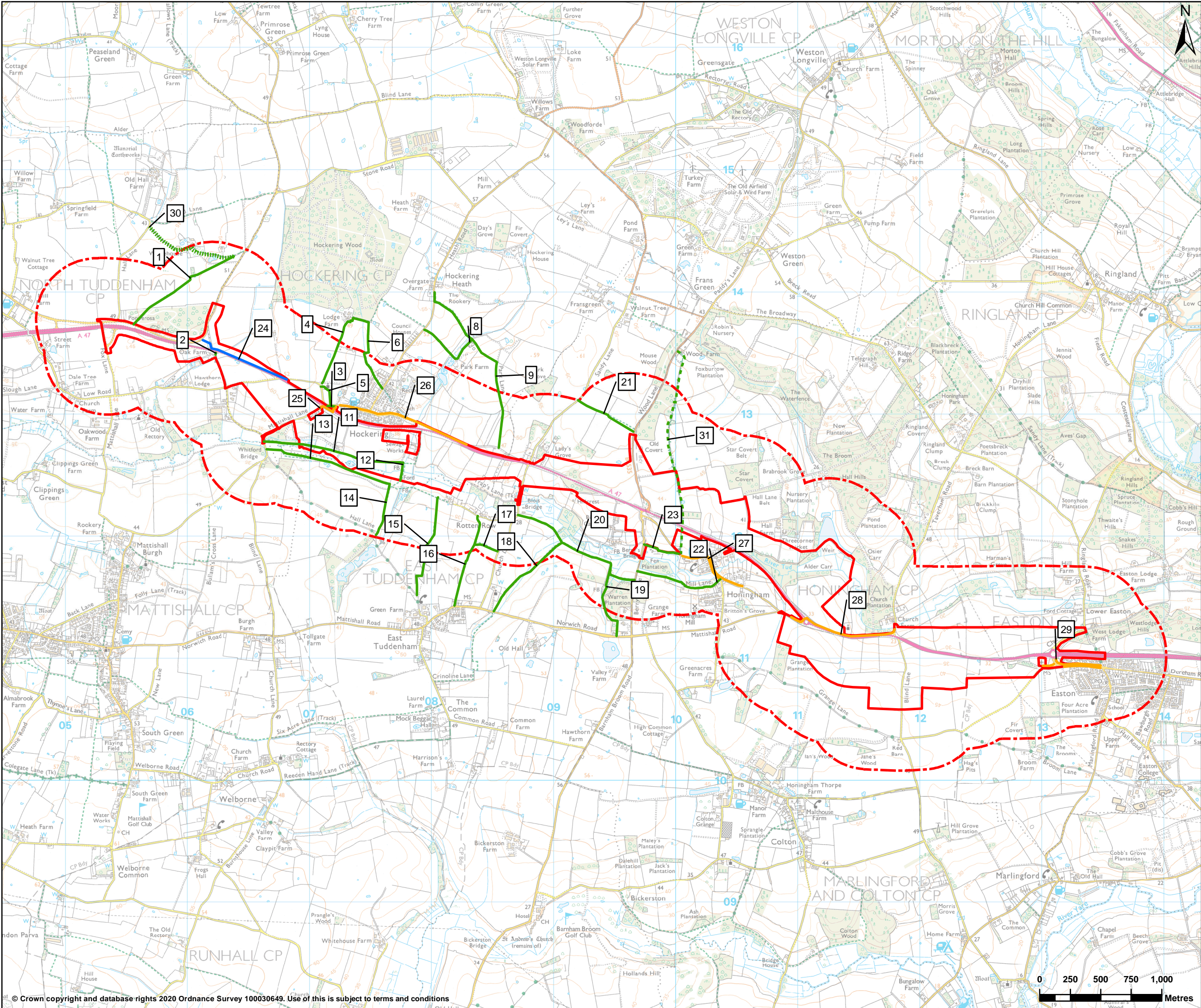
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CONTRACTOR					
<b>GallifordTry</b>					
CLIENT					
<b>highways</b> england					
PROJECT TITLE					
A47 NORTH TUDDENHAM TO EASTON					
PROJECT STAGE					
PCF STAGE 3					
DRAWING TITLE					
FIGURE 7.2: ECOLOGICAL CONSTRAINTS PLAN SHEET 3 OF 3					
SUITABILITY					
FOR INFORMATION					
SHEET SIZE		SCALE	STATUS		
A3		1:12,500	S0		
DRAWING NUMBER					
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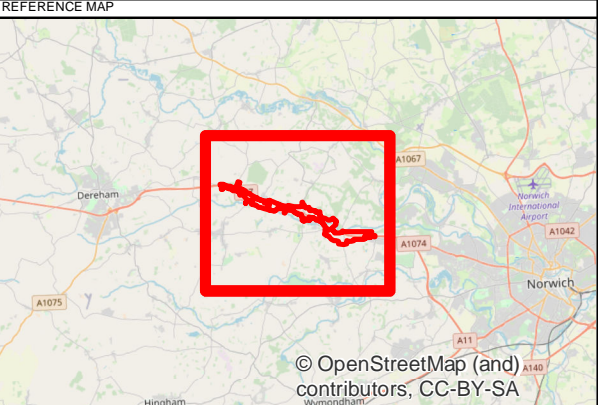
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**LEGEND**

- Scoping boundary
- Scoping boundary 500m buffer
- Public Right of Way (PRoW) - Bridleway
- Public Right of Way (PRoW) - Footpath
- Public Right of Way (PRoW) - Restricted Byway
- Existing combined footway or cycle way
- Existing footways

NOTE: Numbers correlate with the information in the Population and Human Health Chapter

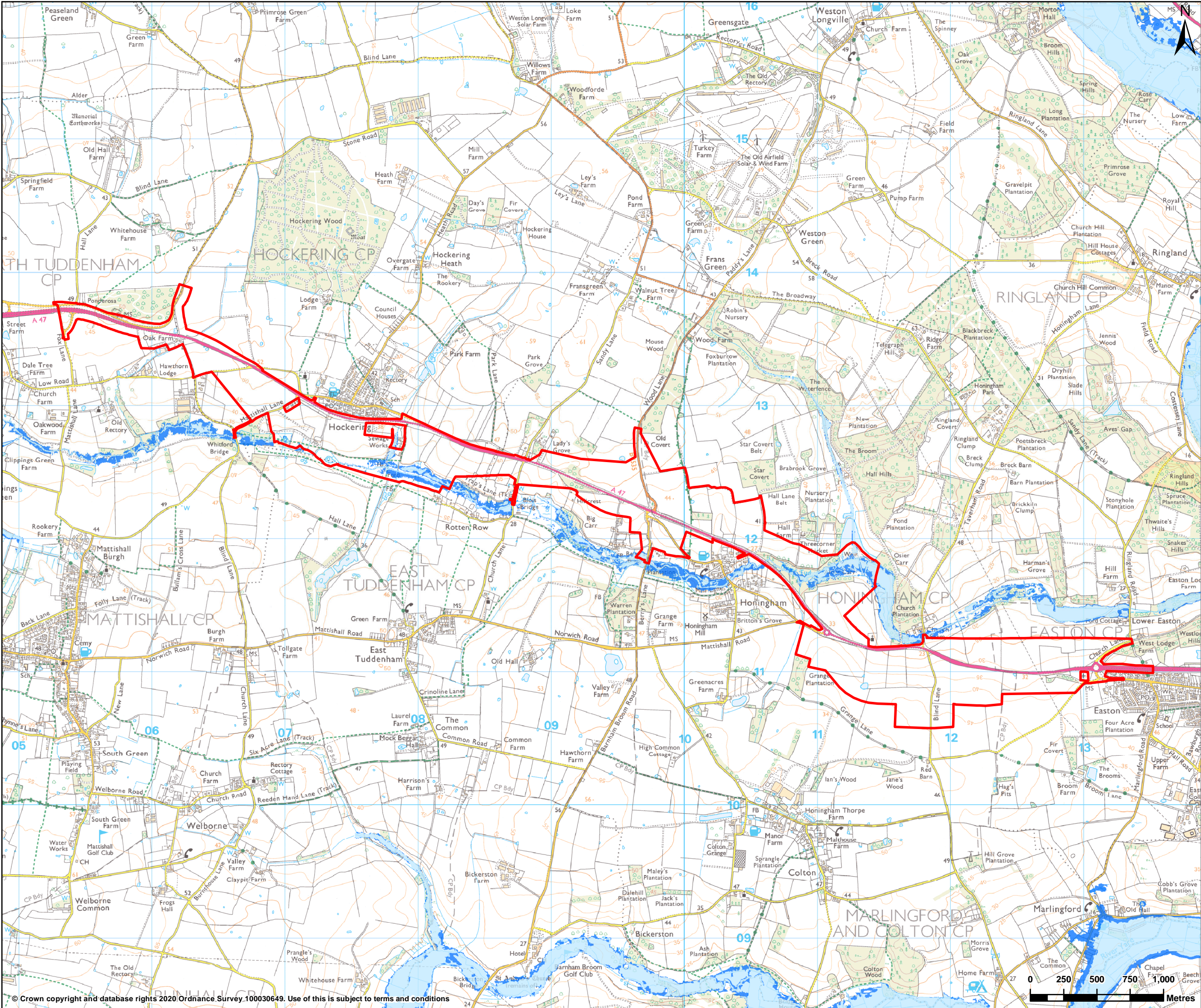
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CLIENT					
PROJECT TITLE					
PROJECT STAGE					
DRAWING TITLE					
SUITABILITY					
SHEET SIZE					
DRAWING NUMBER					

A3	1:30,000	S0
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Scoping boundary

Flood zone 3

Flood zone 2

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REFERENCE MAP

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DESIGNER

CONTRACTOR

CLIENT

PROJECT TITLE

A47 NORTH TUDDENHAM TO EASTON

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 12.1: RIVER FLOOD RISK

SUITABILITY

FOR INFORMATION

SHEET SIZE	A3	SCALE	1:27,500	STATUS	S0
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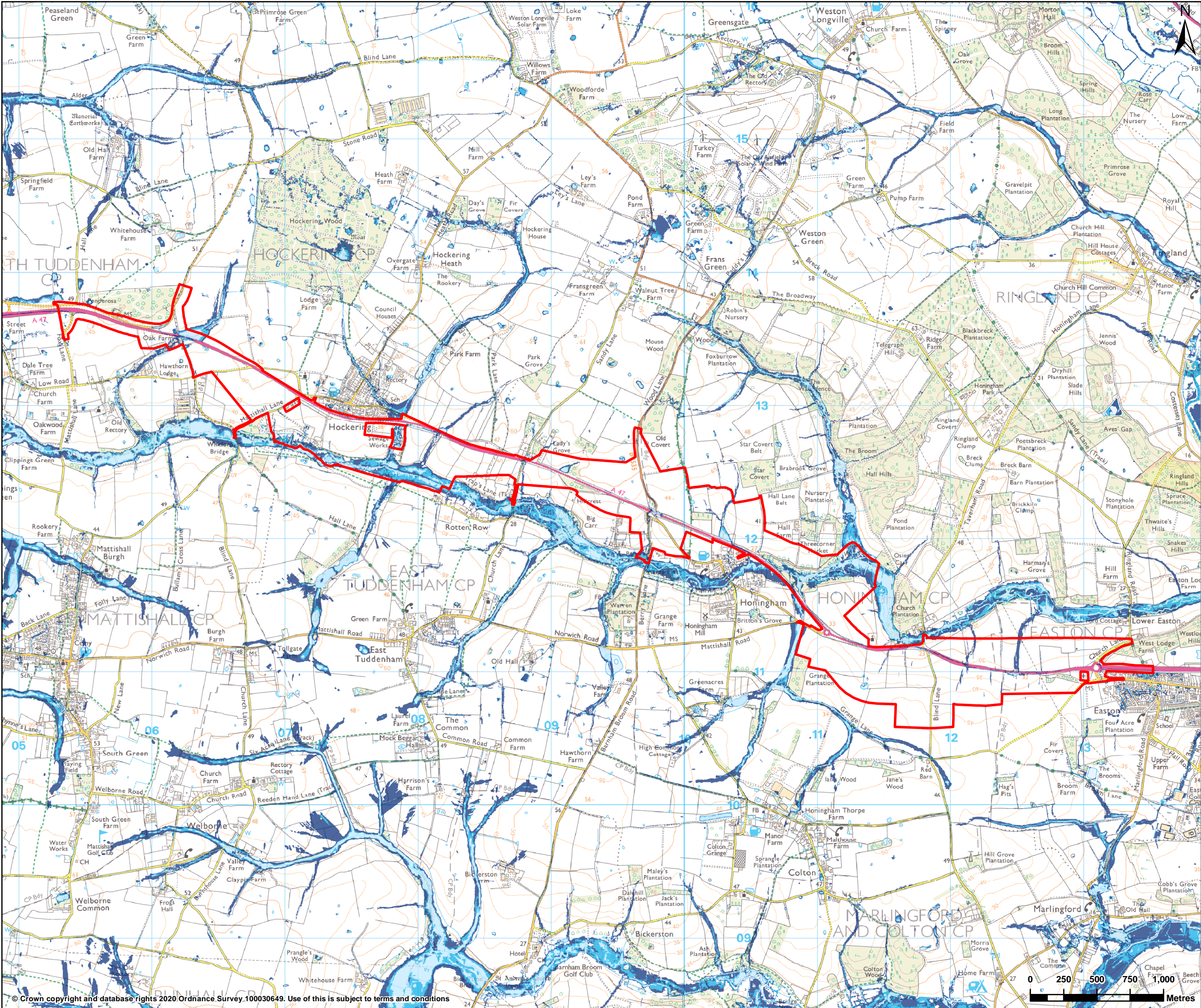
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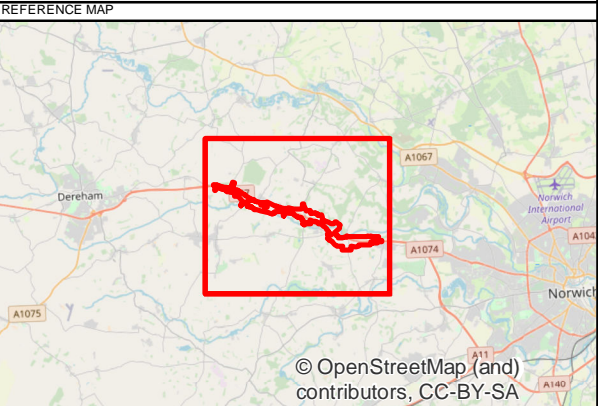




**LEGEND**

- Scoping boundary
- Risk of flooding from surface water - High
- Risk of flooding from surface water - Medium
- Risk of flooding from surface water - Low

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**PROJECT TITLE**

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**PROJECT STAGE**

PCF STAGE 3

**DRAWING TITLE**

FIGURE 12.2: SURFACE WATER CONSTRAINTS

**SUITABILITY**

FOR INFORMATION

SHEET SIZE	SCALE	STATUS
A3	1:27,500	S0

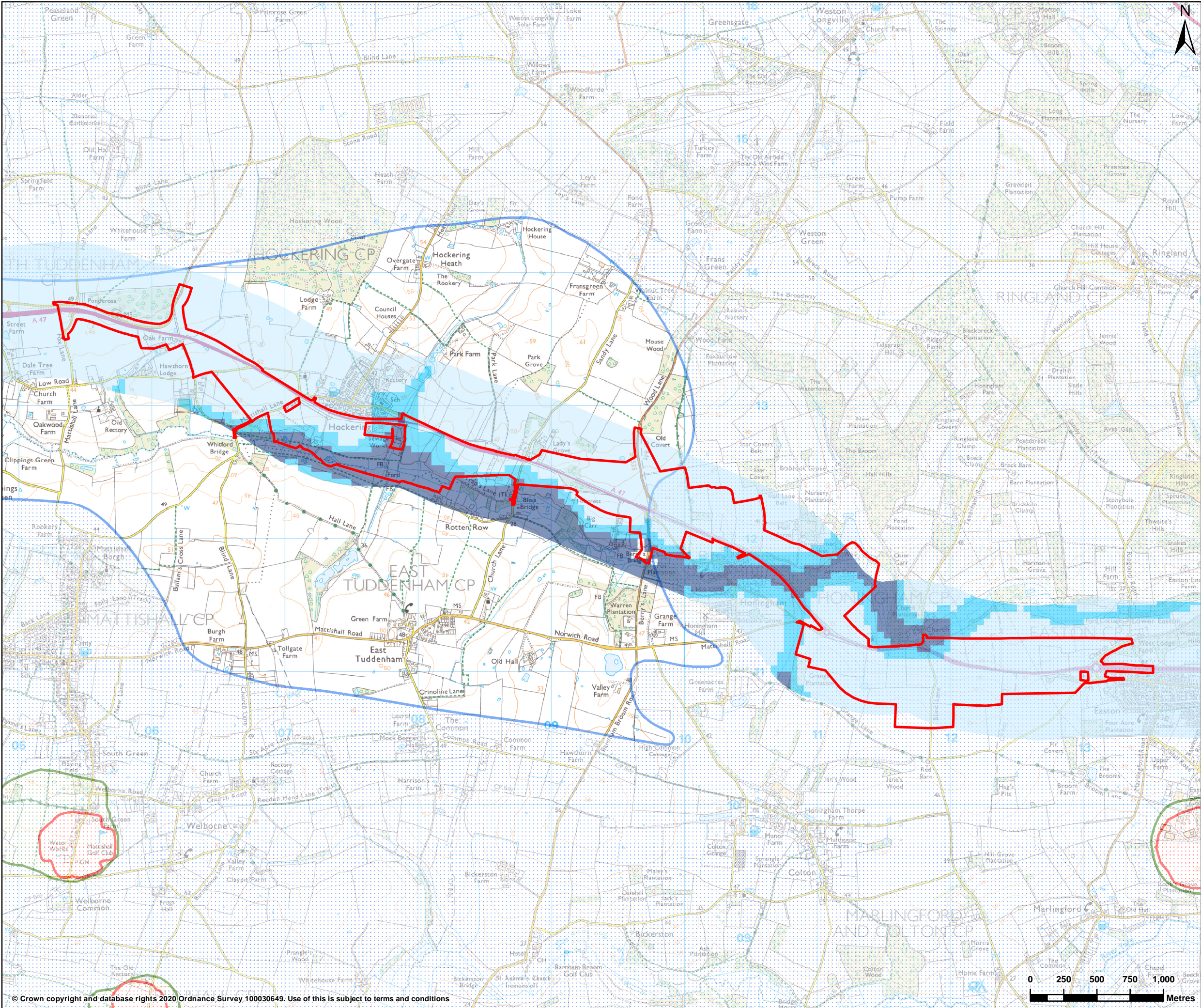
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Scoping boundary

Source protection zone

Zone I - Inner Protection Zone

Zone II - Outer Protection Zone

Zone III - Total Catchment

Susceptibility to groundwater flooding



Limited potential for groundwater flooding to occur

Potential for groundwater flooding of property situated below ground level

Potential for groundwater flooding to occur at surface

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P01	30/01/2020	First Edition	AC	CB	JB
REV	DATE	REVISION NOTE	ORG	CHK'D	APP'D
SIGNER					
<div>SWECO</div>					
CONTRACTOR					
<div></div>					
CLIENT					
<div></div>					
PROJECT TITLE					
A47 NORTH TUDDENHAM TO EASTON					
PROJECT STAGE					
PCF STAGE 3					
DRAWING TITLE					
FIGURE 12.3: GROUNDWATER CONSTRAINTS					
SUITABILITY					
FOR INFORMATION					
SHEET SIZE		SCALE		STATUS	
A3		1:27,500		S0	
DRAWING NUMBER					
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