

# A47/A11 Thickthorn Junction

**Scheme Number: TR010037**

## **Volume 7** **7.3 Scheme Design Report**

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The A47/A11 Thickthorn Junction  
Development Consent Order 202[x]

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**7.3 SCHEME DESIGN REPORT**

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## 1. INTRODUCTION

### 1.1. Purpose of this Report

- 1.1.1. This Scheme Design Report (this “Report”) is submitted by Highways England (the “Applicant”) under section 37 of the Planning Act 2008 (PA 2008) to the Secretary of State for Transport via the Planning Inspectorate (the “Inspectorate”) for a Development Consent Order (DCO) for the A47/A11 Thickthorn Junction (the “Scheme”). A detailed description of the Scheme can be found in Chapter 2 The Proposed Scheme of the Environmental Statement (ES) (**TR010037/APP/6.1**).
- 1.1.2. Highways England’s Licence<sup>1</sup> includes both statutory directions and statutory guidance issued by the Secretary of State, as provided for in section 6 of the Infrastructure Act 2015.
- 1.1.3. Paragraph 5.26 of the Licence states *“In exercising its functions, the Licence holder must have due regard to relevant principles and guidance on good design, to ensure that the development of the network takes account of geographical, environmental and socio-economic context”*.
- 1.1.4. The principles of good design are also noted in ‘*The road to good design*<sup>2</sup>’ and are a requirement of the Design Manual for Roads and Bridges (DMRB) ‘*GG103 Introduction and general requirements for sustainable development and design*’.
- 1.1.5. The aim of this Report is to provide a guide to the design decisions that have informed the development of a good design for the Scheme and assist those reviewing the application documentation. This Report also supports the review of compliance with the design requirements of the National Policy Statement for National Networks (NPS NN) (2019), such as: paragraphs 4.28 to 4.35 that outline criteria for “good design” for national network Infrastructure; and consideration of alternatives option in light of the paragraphs 3.23 to 3.27. For further details refer to the NPS NN Accordance Table (**TR010037/APP/7.2**).

### 1.2. Structure of this Report

- 1.2.1. This Report comprises 11 sections as described below:
- Section 1 – introduces this Report
  - Section 2 – provides a high-level description of the Scheme
  - Section 3 – application of Highways England’s Design Principles
  - Sections 4 to 11 – review of specific design considerations.

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<sup>1</sup> Department for Transport (2015) Highways England Licence. Secretary of State for Transport statutory directions and guidance to the strategic highways company. [online] available at: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/431389/strategic-highways-licence.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/431389/strategic-highways-licence.pdf) (last accessed August 2020).

<sup>2</sup> Highways England (2018) The road to good design (2018). [online] available at: <https://www.gov.uk/government/publications/the-road-to-good-design-highways-englands-design-vision-and-principles>

## 2. THE SCHEME

### 2.1. Scheme Description

- 2.1.1. The Scheme is located on the south-western edge of Norwich and is the intersection between the A47 and A11. The A47 connects Norwich with Great Yarmouth to Leicester and the Midlands via King's Lynn, Wisbech and Peterborough. The A11 is the main route connecting Norwich with Thetford, Cambridge and London (via the M11 and A14). Further details about the location of the Scheme can be found on the Location Plan (**TR010037/APP/2.1**) with further details provided on the General Arrangement Plans (**TR010037/APP/2.2**).
- 2.1.2. The Scheme will upgrade the A47/A11 Thickthorn junction between the A11 South and the A47 Eastern link located west of the village of Cringleford. The Scheme aims to relieve congestion, reduce journey times, support regional housing and economic growth. Further details on how the Scheme meets these objectives can be found in the Case for the Scheme (**TR010037/APP/7.1**).
- 2.1.3. A detailed description of the Scheme is provided in Chapter 2 The Proposed Scheme of the ES (**TR010037/APP/6.1**). In summary, the Scheme comprises:
- a single-lane free-flowing link road connecting the A11 northbound to the A47 eastbound via two underpasses (under the A11 and A47 respectively)
  - improvements to the junction:
    - widening the existing slip road on the A47 westbound and building a dedicated left-hand free flow lane to the A11 southbound
    - widening the southern section of the roundabout from three lanes to four
    - new traffic lights on the approach to / from the junction with the B1172 Norwich Road
    - new road surface on the circulatory, plus new road signs and road markings throughout the junction
  - removal of the Cantley Lane South direct connections between the A11 and A47 exit slip roads
  - new link road connecting Cantley Lane South with the B1172 Norwich Road to the north and construction of two new bridges
  - new junction connecting the B1172 Norwich Road to Cantley Lane Link Road
  - new junction connecting Cantley Lane South to Cantley Lane Link Road
  - existing Cantley Lane stream and access track realigned and one new stream culvert constructed
  - new Cantley Lane Footbridge (Cringleford) over the A47 for walkers, cyclists and horse riders (WCH) approximately 45m south-east of the existing footbridge, which will be demolished; the footbridge will have higher railings to improve safety for horse riders
  - paths for walking and cycling proposed along the new Cantley Lane Link Road giving access to local amenities and links to other recreational routes

- access to the Park and Ride from the Cantley Lane Link Road for walkers and cyclists.

## 2.2. Scheme Objectives

2.2.1. The key objectives of the Scheme are:

- **Supporting economic growth:** the Scheme aims to reduce congestion related delay, improve journey time reliability and increase the overall capacity of the A47. This will help contribute to sustainable economic growth by supporting regional housing and economic growth in Norwich and the surrounding areas.

**A safer and reliable network:** make the network safer for motorists and for those living near the junction by improving operational safety issues at the junction.

**A more free-flowing network:** increase the resilience of the junction to cope with incidents such as collisions, breakdowns, maintenance and extreme weather. Reduce vehicular delay and improve journey time reliability, making journey times more predictable and movement at the junction more free-flowing.

**Improved environment:** protect the environment by minimizing adverse impacts and, where possible, deliver benefits.

- **An accessible and integrated network:** consider local communities and their access to the roads. Provide a safer route between communities for cyclists, walkers, horse riders and other vulnerable users of the network.
- **Value for money:** to ensure that the Scheme is affordable and delivers good value for money.

## 2.3. Geographical and Socio-economic Context

### Introduction

2.3.1. This section summarises the geographical, environmental, socio-economic and health receptors that have the potential to be affected by the Scheme, in accordance with the criteria set out in DMRB.

2.3.2. The study areas for each topic are described in technical Chapters 5 to 14 of the ES (TR010037/APP/6.1).

### Air quality

2.3.3. There are currently no Air Quality Management Areas (AQMAs) declared in the Broadland District Council or South Norfolk Council boundaries. The nearest AQMA to the Scheme is the Central Norwich AQMA over 3km to the north-east, within Norwich City Centre, declared by Norwich City Council.

2.3.4. Further details can be found in Chapter 5 Air Quality of the ES (TR010037/APP/6.1).

### Cultural heritage

2.3.5. Cultural heritage assets have been identified as either located within the DCO boundary, within the zone of theoretical influence or potentially affected by noise.

- 2.3.6. There is a Scheduled Monument, which is Two Tumuli in Big Wood, located outside of but surrounded by the DCO boundary between the A11, Cantley Lane South Link, Cantley Lane South and the A47-A11 Connector Road. The Milestone No.4 Grade II listed structure lies within the DCO boundary. There are six additional Grade II listed buildings and one Grade II\* listed building within the or zone of theoretical visibility (as defined in Chapter 6 Cultural Heritage of the ES (TR010037/APP/6.1)). The assessment also considers 13 non-designated historic buildings.
- 2.3.7. There are no World Heritage Sites or Registered Battlefields recorded within the study area. Further details can be found in Chapter 6 Cultural Heritage of the ES (TR010037/APP/6.1).

### **Landscape and visual**

- 2.3.8. The DCO boundary lies adjacent to and encompasses the existing A47 near the settlements of Cringleford and Hethersett, west of Norwich. This is a lowland agricultural area, characterised by medium scale rectilinear fields bound by hedgerows and linear belts of trees.
- 2.3.9. The Scheme is in a mainly rural location with the village of Cringleford (forming the south western fringes of Norwich) approximately 500m to the east; although there is an on-going housing development to extend the urban footprint closer to the Scheme. The Norfolk and Norwich Hospitals are approximately 1km to the north and the village of Hethersett lies approximately 2km to the west. A more extensive area of sparsely populated open countryside lies to the south. Thickthorn Hall and its parkland lies between the Scheme and Hethersett.
- 2.3.10. Thickthorn Hall is a Registered Park and Garden (RPG) at County level and extends eastwards towards the Thickthorn Park and Ride site.
- 2.3.11. Further details can be found in Chapter 7 Landscape and Visual of the ES (TR010037/APP/6.1).

### **Biodiversity**

- 2.3.12. Within 2km of the DCO boundary are seven statutory designated nature conservation sites:
- The Broads Special Area of Conservation (SAC)
  - Broadland Special Protection Area (SPA)
  - Broadland Ramsar
  - Eaton Chalk Pit Site of Special Scientific Interest (SSSI)
  - Eaton Common Local Nature Reserve (LNR)
  - Earlham Park Woods LNR
  - Marston Marshes LNR
- 2.3.13. There are 19 Country Wildlife Sites (CWS) located within 2km, but no internationally protected SACs designated for bats within 30km of the Scheme.
- 2.3.14. Further details can be found in Chapter 8 Biodiversity of the ES (TR010037/APP/6.1).



### **Geology and soils**

- 2.3.15. No designated or sensitive geological assets were identified within the DCO boundary.
- 2.3.16. Further details can be found in Chapter 9 Geology and Soils of the ES (TR010037/APP/6.1).

### **Materials and waste**

- 2.3.17. The Scheme intersects part of a known sand and gravel reserve (mineral safeguarding area) designated as a mineral safeguarding area by Norfolk County Council.
- 2.3.18. Further detail is provided in Chapter 10 Material Assets and Waste of the ES (TR010037/APP/6.1) and Appendix 10.4 Mineral Impact Assessment of the ES (TR010037/APP/6.3), which also concludes it is not anticipated that any mineral safeguarding sites will be sterilised.

### **Noise and vibration**

- 2.3.19. Sensitive receptors, such as residential properties, in proximity to the Scheme have been identified. Human receptors reside in small groups of residential properties located at East Lodge and Thickthorn Cottages on the B1172. On Cantley Lane South there is one group of 12 properties, whilst there are an additional five properties further south-west of the A47. A single residential property (the Round House) is located east of Thickthorn junction and approximately 50m north of the A11.
- 2.3.20. There are residential properties concentrated in Cringleford to the east of the A47, both to the north and south of the A11. An ongoing development of 1,200 additional residential units lies close to the junction. There are also a number of non-residential sensitive receptors in Cringleford, including a primary school. There is one Noise Important Area<sup>3</sup> east of the Round House Roundabout on the A11 included in the noise and vibration assessment.
- 2.3.21. Further details can be found in Chapter 11 Noise and Vibration of the ES (TR010037/APP/6.1).

### **Population and human health**

- 2.3.22. In 2011, across the Broadland district the population was estimated to be 129,464 and across South Norfolk it was estimated to be 124,012 (Census, 2011).
- 2.3.23. The area is of relative affluence and high employment. There are proportionally more economically active people in Broadland (87%), South Norfolk (85%) and Norfolk (78%) than in England (77%). It also shows that employment is higher in Broadland (83%), South Norfolk (84%) and Norfolk (78%), compared to across England (77%).
- 2.3.24. Broadland is primarily an agricultural area with interspersed residential housing, community and commercial facilities. Cringleford and Hethersett are the main

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<sup>3</sup> Areas identified by the Government in the below DEFRA website for action to control noise levels:  
<https://data.gov.uk/dataset/fc786717-3756-4fd1-9c7d-c082331e40e4/noise-action-planning-important-areas-round-2-england>

population centres within 500m of the Scheme and are connected by the existing A47 and A11. Norwich is the nearest city to the east, connected by the existing A47.

- 2.3.25. There are several community facilities within the 500m of the Scheme, including: a service station, veterinarian surgery, doctor's surgery, two fast food restaurants, a hotel, Thickthorn Park and Ride, a community centre, Intwood Hall RPG, a Church hall, and a primary school.
- 2.3.26. The planned Cringleford Residential Development is located adjacent to the north east of the Scheme and proposes the development of 890 new dwellings. The Greater Norwich Local Plan (GNLP) will also support the growth of employment and residential housing.
- 2.3.27. There are no national cycle network routes or national walkways crossing through the DCO boundary, though there are two local cycle routes and Pedalways which pass through the DCO boundary.
- 2.3.28. There are also two local walking routes, one equestrian bridleway and seven public rights of way (PRoW), including Cringleford FP4a which runs from Cantley Lane to a footbridge over the A47 to provide a link to Cantley Lane South. There is a shared-use footway on the northern side of the Thickthorn junction roundabout from the B1172 (Thickthorn Park and Ride) arm to the old Newmarket Road arm. There are several Toucan crossings on the A47 and A11.
- 2.3.29. Further details can be found in Chapter 12 Population and Human Health of the ES (**TR010037/APP/6.1**).

#### **Road drainage and the water environment**

- 2.3.30. The Scheme is located within two main river catchment areas and the Scheme lies predominantly in the Environment Agency defined Flood Zone 1 (low risk) for these rivers. However, some areas lie within Flood Zones 2 (medium risk) and 3 (high risk) that are associated with the Cantley Stream where it passes under the A11, west of Thickthorn junction, and joins the River Yare downstream.
- 2.3.31. The area is underlain with by a Groundwater Source Protection Zone 3 due to the presence of a secondary A superficial aquifer (Sheringham Cliffs Formation) and a principal aquifer.
- 2.3.32. Further details can be found in Chapter 13 Road Drainage and the Water Environment of the ES (**TR010037/APP/6.1**).

#### **Climate**

- 2.3.33. The Climate Change Act 2008 is central to the UK Government's plan to reduce carbon emissions, committing the UK to a reduction of 80% against 1990 levels by 2050. On 1 May 2019, the UK Government declared a climate emergency, leading to updating the commitments in the 2008 Act to target net zero carbon emissions by 2050 under the Climate Change Act (2050 Target Amendment) Order 2019.

Climate change adaptation requires more than just managing carbon emissions. Therefore, Chapter 14 Climate of the ES (**TR010037/APP/6.1**) assesses the various impacts on climate change and associated mitigation measures by the Scheme. This chapter also assesses the potential impacts by the Scheme and measures to adapt in response to climate change.

### 3. DESIGN PRINCIPLES

#### 3.1. Introduction

3.1.1. Following the first '*Road Investment Strategy (RIS1) 2015/16 to 2019/20*' published in March 2015, the second '*Road Investment Strategy 2020 to 2025*<sup>4</sup>' (RIS2) published in March 2020 sets a long-term strategic vision for the network by:

- specifying the performance standards Highways England must meet
- listing planned enhancement Schemes expected to be built
- stating the funding made available during the second Road Period (RP2), covering the financial years 2020-21 to 2024-25.

3.1.2. Ensuring this strategic vision is at the centre of the development and delivery of road schemes requires a design led culture to be developed by the Applicant. Highways England's '*The Road to Good Design*' (2018)<sup>5</sup> and DMRB '*GG103 Good road design*' identify ten principles of good design that the Applicant has applied to the Scheme. Good road design:

- is safe and useful
- is inclusive
- is understandable
- fits in context
- is restrained
- is thorough
- is sustainable
- is innovative
- is long lasting
- is a collaborative process

3.1.3. Each of the above ten design principles has been considered in developing the Scheme design. In addition, the Scheme has considered how a reduction in carbon emissions can be achieved through the Scheme design.

#### 3.2. Is Safe and Useful

3.2.1. The Scheme will include speed reductions on some of the key routes to make these safer for both vehicle users and pedestrians. This will include reducing the speed on the B1172 Norfolk Road from the national speed limit (60mph for single carriageway or 70mph for dual carriageway) to 40mph, making it safer for vehicles to exit the new Cantley Lane Link Road onto the B1172 Norfolk Road.

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<sup>4</sup> Department for Transport (2020) Road Investment Strategy 2: 2020 - 2025 [online] available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/872252/road-investment-strategy-2-2020-2025.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/872252/road-investment-strategy-2-2020-2025.pdf)

<sup>5</sup> Highways England (2018) The road to good design. [online] available at: <https://www.gov.uk/government/publications/the-road-to-good-design-highways-englands-design-vision-and-principles>

- 3.2.2. Several measures have been introduced to help reduce traffic congestion at the Thickthorn junction:
- A segregated left-turn lane will be provided from the A47 westbound diverge to the A11 southbound to allow strategic traffic to bypass the Thickthorn roundabout. This will reduce traffic congestion on the A47 northbound diverge slip road and reduce journey times, making roads more useful for vehicle users.
  - At the A11-A47 Connector Road a free-flow link road will be provided from the A11 northbound to the A47 eastbound which will allow traffic travelling in this direction to bypass the Thickthorn roundabout. This will also reduce traffic congestion at the junction and reduce journey times.
  - The Thickthorn roundabout would be widened through the inclusion of an additional lane between the A11 southbound approach arm and the A11 southbound exit arm of the roundabout. This will reduce congestion on the roundabout.
  - Reducing congestion at the Thickthorn junction will assist in supporting economic growth in the area and provide improved access for planned new housing developments, such as the Cringleford Residential Development to the north-east of the Scheme.
- 3.2.3. Additional safety measures have been incorporated into walking, cycling and horse-riding (WCH) routes as follows:
- A refuge island will be incorporated into the junction of the Cantley Lane Link Road with the B1172 Norwich Road, to facilitate the safe crossing between the proposed shared footway/cycleway and the existing facility provided on the northern frontage of Norwich Road, which comprises part of the Wymondham to Sprowston Pedalways cycle route.
  - The existing PRoW footpath Cringleford FP 4a and WCH crossings at the Thickthorn junction will be removed as part of the Scheme. The Cringleford PRoW FP4a will be diverted to the proposed Cantley Lane footbridge over the A47, to provide a safer crossing by removing the current requirement for WCH users to cross the carriageway at grade.
- 3.2.4. The integration of WCH routes and the adjacent Thickthorn Park and Ride site presents an opportunity to support modal shift within the vicinity. This would encourage people to use different forms of transport and reduce congestion at the Thickthorn junction, connecting them into a wider movement network. The WCH routes have been developed in consultation with Norfolk County Council to ensure the routes consider the specific requirements of the area. This also supports the requirements of NPS NN paragraphs 3.17 to 3.20 (sustainable transport) and 3.21 to 3.22 (accessibility).
- 3.2.5. GG 142 of the DMRB sets out the walking, cycling and horse-riding assessment and review (WCHAR) process for highway schemes on motorways and all-purpose trunk roads. The level of detail required for the assessment is dependent upon the size of the Scheme, which in turn defines the study area.
- 3.2.6. A WCHAR process has been undertaken as part of the Scheme. The assessment presented in Chapter 12 Population and Human Health of the ES

(**TR010037/APP/6.1**) sets out the significance of impacts from altering a PRoW and creating of a new provision to improve safety for WCH users south of the Scheme.

### **3.3. Is Inclusive**

- 3.3.1. The Scheme design incorporates a new footway/ cycleway on the eastern frontage of the Cantley Lane Link Road to enable easier access for walkers and cyclists and encourage active travel. A refuge island would also be provided on the B1172 Norwich Road to enable safer crossing for pedestrians.
- 3.3.2. The Scheme includes the provision of a new Cantley Lane footbridge (Cringleford), suitable for all WCH users, spanning the A47 and A11-A47 Connector Road to the south of Thickthorn junction; this will replace the existing footbridge, linking Cantley Lane South and Cantley Lane, that is to be demolished.
- 3.3.3. PRoW footpath Cringleford FP4a will be diverted to the new footbridge to increase connectivity and inclusivity by allowing more users to utilise the PRoW.

### **3.4. Is Understandable**

- 3.4.1. New signage is proposed as part of the Scheme on several different features, to make sure the features are clear and understandable for vehicle users and pedestrians, such as follows:
- Signage on Cantley Lane South and on the proposed Cantley Lane footbridge (Cringleford) crossing the A47, joining Cantley Lane and Cantley Lane South. This would make sure the new route is understandable for vehicle users.
  - Signage is proposed for the new Cantley Lane Link Road to advise road users of the change in the speed limit.
- 3.4.2. To improve visibility on the B1172 Norwich Road, a ghost island is proposed to allow vehicle users to clearly see ahead and provide space to turn.
- 3.4.3. Fencing has been allowed for at the highway boundary to clearly delineate landownership and for safety and security. With the exception of where alternatives have been agreed with neighbouring landowners or been specified for environmental mitigation, timber post and rail fence would be provided in accordance with Manual of Contract Documents for Highway Works standard details.

### **3.5. Fits in Context**

- 3.5.1. The A47 junction at Thickthorn is located within a rural landscape context but close to the western edge of Norwich. The rural landscape beyond the existing urban area is also locally modified by the confluence of several highway routes and the presence of services, a park and ride site and overhead power lines. Protecting the surviving distinction between the adjacent rural and urban areas and, wherever possible, retaining the quiet, peaceful, rural character of the underlying wider countryside away from the main trunk road infrastructure underpins the approach to the landscape design of the Scheme.
- 3.5.2. The underlying rural landscape at Thickthorn is characterised by agricultural land use, dispersed settlement, narrow country lanes and mature field boundary and parkland-style trees. The landscape pattern generally comprises larger arable fields but with smaller pastoral land parcels associated with the shallow valleys along watercourses such as at Cantley Stream. Woodland cover is quite frequent. Some

woodland is associated with remnant parkland areas such as around Thickthorn Hall with frequent linear belts associated more with the A11 and A47 highway corridors. There are relatively few true and regularly trimmed hedgerows with field boundaries generally comprising fencing, intermittent informal vegetation and frequent mature field boundary trees.

- 3.5.3. The environmental design seeks to integrate the Scheme with surrounding landscape character, minimise visual intrusion, and, wherever possible, preserve the informal rural character of the landscape away from the trunk road infrastructure. The design objectives therefore include notable extents of woodland and tree planting to replicate existing features and to establish visual screening. Structures will be either steel or concrete, eliminating the requirement for painting. The environmental mitigation strategy also seeks to reinstate landscape features lost as a result of the Scheme, such as occasional hedgerow boundaries (e.g., at Norwich Road) and woodland, as well as general enhancement of the landscape context wherever possible.
- 3.5.4. The objectives of the Scheme to ensure integration with the existing landscape include:
- retaining the pervading sense of rural informality and visual openness in the vicinity of Cantley Lane South and in remnant parkland areas towards Norwich Road where this is consistent with a balanced preference for visual screening
  - integrating Scheme infrastructure (notably the elevated overbridges) through appropriate use of woodland planting on embankments to contribute to topographical assimilation and visual screening (principally in views from open countryside areas to the south west)
  - compensating for woodland removal, particularly to the north of the A11, by inclusion of new wooded areas in this vicinity
  - reinforcing existing field boundaries and the remnant parkland character around Thickthorn Hall with individual trees of appropriate species
  - selecting plant and grass species appropriate to the locality to maintain consistency with the appearance of the area
  - inclusion of a mosaic of grassland, scrub, woodland copse and individual tree planting over a hummocky landform within areas to the south of the interchange to enhance biodiversity with a focus on reptile habitats
  - enhancement and re-creation of water vole habitats along the existing and realigned sections of Cantley Stream to protect biodiversity but also to preserve and enhance the distinct, peaceful, rural character of the shallow valley.
- 3.5.5. Section 6 of this Report provides further information on how the landscape design has been integrated into the design of the Scheme with surrounding landscape character to minimise visual intrusion.

### **3.6. Is Restrained**

- 3.6.1. The proposed Cantley Lane Link Road and proposed A11-A47 Connector Road have been positioned to minimise the potential impact predicted on existing infrastructure. The chosen position has ensured certain measures have not been

required to be taken. For example, Cantley Lane Link Road was positioned to avoid demolition of property, while the A11/A47 Connector Road was positioned to avoid widening bridges, demolition of buildings and moving high voltage overhead electricity lines.

- 3.6.2. Section 4 of this Report provides further information on considerations applied during the design of the Scheme around Thickthorn junction to minimise the potential impact predicted on existing infrastructure and the environment.

### **3.7. Is Thorough**

- 3.7.1. This design process has included teams of professionals in a wide range of disciplines including engineers, environmental specialists, traffic modellers, contractors and legal advisors. These professionals have undertaken a collaborative and iterative process to thoroughly explore approaches to be included within the Scheme design. This has enabled flexibility to incorporate changes into the Scheme design, following the findings of surveys, the environmental assessment, consultation and Scheme design reviews, to achieve betterment in the design.
- 3.7.2. For example, in relation to the Cantley Stream re-alignment a wide range of environmental disciplines, including water, ecology and landscape specialists, worked collaboratively with the engineering design team to ensure the designed culvert size did not significantly increase the risk of flooding. In this way the Applicant avoided the need to provide flood compensation areas, did not increase the risk of flooding further downstream and minimised any adverse impacts on protected species and the landscape.
- 3.7.3. Throughout the design process, options have been developed and screened to identify preferred solutions based on a comparison of the options performance against safety, environmental, engineering, transportation and economic criteria. This process was supplemented by feedback from consultation with stakeholders and the public to ensure the design meets the needs of the end users.
- 3.7.4. In addition to statutory consultation with stakeholders and the public, the Applicant has undertaken on-going technical meetings with a wide range of external specialist consultees, such as the Local Authorities and statutory environmental bodies. For example, the structures design, Environmental Impact Assessment (EIA) and flood risk discipline leads, and the Applicant's Principal Contractor participated in iterative design reviews with the Environment Agency and Norfolk County Council, as the Lead Local Flood Authority (LLFA), to review the options and agree the preferred design for the new Cantley Stream realignment.
- 3.7.5. Section 5 of this Report outlines the options considered when assessing the design and build options for each main structure. Further information on stakeholder engagement can be found in the Consultation Report (**TR010037/APP/5.1**) and the ES (**TR010037/APP/6.1**).

### **3.8. Is Environmentally Sustainable**

- 3.8.1. As part of the EIA and in accordance with NPS NN paragraph 3.2 (environment and social impacts), the design has been influenced through embedding mitigation and enhancement measures into the design as early as possible, as follows:

- Environmental constraints have been avoided where possible, such as nature conservation sites and Listed Buildings.
- Biodiversity proposals include the introduction of species-rich grassland, water vole habitat creation to facilitate translocation of this protected species and creation of habitat suitable for reptiles.
- Opportunities have been maximised, with new WCH routes to connect communities and habitat creation through careful planting design.

3.8.2. Chapter 14 Climate of the ES (**TR010037/APP/6.1**) also discusses how the Scheme considered and manages its effects on the climate (i.e., carbon emissions) and potential vulnerability to climate change (i.e., resilience to projected climate changes). This supports the requirements of NPS NN paragraphs 4.38 to 4.46 (climate change adaptation) and 5.17 – 5.19 (carbon emissions).

3.8.3. For more detail on other environmental mitigation refer to the ES (**TR010037/APP/6.1**).

3.8.4. The increase in areas of hard standing and alteration of ground elevations due to re-profiling would result in an increase in peak flow rates discharging to Cantley Stream. The flood risk to and by the Scheme and the drainage design are discussed in Chapter 13 Road Drainage and the Water Environment of the ES (**TR010037/APP/6.1**). The flood risk modelling followed planning policy guidance and assumed a peak river flow climate change allowance of 65%. The assessment of surface water flood risk also applied the planning policy guidance on climate change that required revised peak rainfall intensity to be assumed to be between 20% and 40%, for the central and upper end allowances respectively.

3.8.5. Any increase in surface water runoff is to be attenuated using oversized pipes and attenuation ponds, designed to restrict new drainage systems to the greenfield runoff rate up to a 1 in 100-year rainfall event, with a 20% climate change allowance. A sensitivity test was also undertaken to test a 40% climate change allowance to consider impacts to the Scheme drainage as well as downstream receptors.

3.8.6. For existing drainage systems that are modified as part of the Scheme, there is to be no increase in existing runoff rate including a 20% climate change allowance for contributing new hardstanding areas; these standards are in accordance with DMRB '*CG 501 Design of highway drainage systems*'. This will mean there is no increase in surface water runoff peak flow rate resulting from the Scheme.

3.8.7. For more detail on other environmental mitigation refer to the ES (**TR010037/APP/6.1**).

### **3.9. Is Innovative**

3.9.1. Two distinct areas of weak and compressible Made Ground were identified at the former Cantley Lane Landfill, east of the existing A11, and a historic infilled gravel pit, west of the existing A47. Innovation and sustainability were key drivers in selecting the foundation solution for the proposed embankments at these locations.

3.9.2. Traditional ground improvement solutions, such as a piled embankment or excavation and replacement below the embankment, would have resulted in a cost and materials intensive design option which would disturb contaminated ground in the vicinity of sensitive environmental receptors.



3.9.3. As an alternative, a foundation mattress solution was adopted. Using geogrids to form a cellular structure at the base of the embankments, the foundation mattress acts as a stiff raft across the weak and compressible ground, providing stability, as well as increasing the ground's bearing capacity and minimising overall settlement of the embankments. Unlike traditional solutions, the mattress does not require heavy machinery or level ground and can be installed by hand across the existing ground profile, further minimising the impact of construction.

### **3.10. Long-Lasting**

3.10.1. The Applicant has positioned maintenance facilities on the road network to make sure the interaction between maintenance vehicles and fast-moving traffic is minimised, and that personnel undertaking inspection activities spend as little time in the vicinity of fast-moving traffic as possible. This will enable maintenance and repairs to be undertaken in a safe and timely fashion, thus prolonging the life of the road pavement and associated facilities.

3.10.2. To allow maintenance and inspection works to be carried out safely while keeping traffic flowing, the Applicant has provided safe working areas at the pumping station on the A11-A47 Connector Road and Thickthorn roundabout, along with a hard shoulder on the A11-A47 Connector Road. These locations will allow regular inspection and maintenance to be undertaken safely and ensuring the assets are well maintained throughout the operation of the Scheme.

3.10.3. In accordance with DMRB CD 377 – Requirements for road restraint systems<sup>6</sup>, appropriate safety barriers (Road Restraint Systems) have been included where required by the outcome of a risk assessment.

3.10.4. Section 6 of this Report provides further information on how the design principles have influenced the landscape design to develop an environmental design planting strategy that is resilient and able to adapt to future needs, while accommodating standard highway practices for long term operational maintenance and management.

### **3.11. Is Collaborative**

3.11.1. The Applicant has encouraged an open dialogue with stakeholders across all stages of the development of Scheme. This has allowed the Applicant to capture feedback on the different options proposed to inform decision-making on the most viable option. Key stakeholders throughout the process have included Statutory Environmental Bodies, Norfolk County Council, South Norfolk Council and the parish councils.

3.11.2. The Applicant has also undertaken options and statutory consultation with the local community and other interested organisations. This has included meetings with landowners, public consultation events and facilitating engagement from numerous user groups, such as IE Travel Lodge Thickthorn and Norwich Amateur Bicycle Club.

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<sup>6</sup> Highways England Structures & Bridge Design CD 377 Requirements for Road restraint systems [online]  
<https://www.standardsforhighways.co.uk/prod/attachments/1fe48581-82ba-4b6f-95a1-ee93309bd1b5?inline=true>

- 3.11.3. The Applicant has had regard to the feedback received from the options and statutory consultation update the design accordingly to meet the needs of road users and local communities, such as changes to the proposed side road network.
- 3.11.4. Further information on how the Applicant has had regard to the feedback received at statutory consultation can be found in Annex M of the Consultation Report (**TR010037/APP/5.2**).
- 3.12. Design amendments to reduce carbon**
- 3.12.1. Carbon emissions for the Scheme have been calculated for the design using the Highways England Carbon Tool (version 2.3)<sup>7</sup>. This has allowed for the consideration of carbon in the design process, resulting in the development of a carbon baseline from which further reductions may be made.
- 3.12.2. In accordance with the DMRB LA 114 Climate guidance, the Applicant sought to minimise carbon emissions as far as possible in all cases in order to contribute to the UK's net reduction in carbon emissions. This approach also supports the requirements of NPS NN paragraphs 4.38 to 4.46 (climate change adaptation) and 5.17 – 5.19 (carbon emissions). A hierarchical approach to carbon management has been applied, which applies the principles of build nothing, build less, build clever and build efficiently; as described in PAS (Publicly Available Specification) 2080: Carbon Management in Infrastructure.
- 3.12.3. This process identified efficiencies within the structures design accounted for a saving of 3,128 tCO<sub>2</sub>e from the structural concrete. Concrete volumes were further reduced by proposing a launched reinforced concrete box solution and discounted the embedded pile abutment proposal for the underpasses. Additional material, buildability and construction programme efficiencies were achieved through reducing the deck width of Cantley Wood overbridge and Cantley Wood Link Road overbridge, a reduction in the required volume of drainage attenuation tank and designing out the need for a Cantley Stream diversion culvert.
- 3.12.4. In addition, potential efficiencies have been identified associated with earthworks bunds located south of the Thickthorn junction between the A11 and A47. These have been calculated within the current carbon estimate as imported fill. However, there may be an opportunity to use site won material which would generate carbon savings of approximately 4,378 tCO<sub>2</sub>e. These savings are dependent on further ground investigations scheduled to confirm the suitability of site won material, but at this stage there is a degree of confidence that excavated fill will be suitable for reuse on site.
- 3.12.5. The use of the Highways England Carbon Tool to monitor and manage carbon will continue throughout the construction period to ensure an ongoing focus on climate change mitigation.
- 3.12.6. Further information on the assessment of carbon and associated impact of the Scheme on or by climate change are considered in Chapter 14 Climate of the ES (**TR010037/APP/6.1**).

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<sup>7</sup> Highways England Carbon Tool Manual [online] available:  
[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/899360/Highways\\_England\\_Carbon\\_Tool\\_Guidance\\_Document\\_v2.3.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/899360/Highways_England_Carbon_Tool_Guidance_Document_v2.3.pdf)

## 4. JUNCTION AND LINK ROAD DESIGN

### 4.1. Overview

- 4.1.1. An operational assessment of the existing Thickthorn junction was undertaken as part of the Scheme Assessment Report<sup>8</sup> in January 2018 to understand the capacity deficiencies of the junction. This assessment showed that the Thickthorn junction is operating over capacity on a number of approaches and the junction is unsuitable to accommodate both the dominant movement between the A11 south and A47 east (in both directions) and the strong tidal movements through the junction on the A11 during peak hours.
- 4.1.2. Therefore, options were developed to improve traffic flows between the A47 and A11 to provide a safer and more reliable network that would also support regional economic growth. The options for the Scheme were identified and appraised through an optioneering exercise with the option which forms the Scheme at application being selected following transport, economic, environmental assessments and consultation. Further information on the options and the optioneering process can be found in Chapter 2 of the Case for Scheme (**TR010037/APP/7.1**).
- 4.1.3. In summary, the transport assessment was predominantly based on route length. The shorter the route, the lower likely journey times and the more favourable the option was rated in the assessment.
- 4.1.4. The economic impact assessment reviewed both the costs of each option and the benefits to the local and wider economy, the reduction in delays, accidents and improved journey times to provide a Benefits to Cost Ratio (BCR) to determine value for money.
- 4.1.5. The EIA established the impacts and mitigation measures of each option.
- 4.1.6. The preferred option was also informed by existing constraints, such as land in the north-west quadrant that accommodates Thickthorn Park and Ride, Thickthorn Services, a hotel, a restaurant, an electricity substation and a petrol filling station, which are to be retained and will require access to be maintained throughout construction of the Scheme. There are a number of designated historic assets, including a Scheduled Monument (Two Tumuli in Big Wood) to the south-west, that needs to be protected.

### 4.2. Link Road Design

- 4.2.1. Two link roads will be constructed between the A11 to A47 and the A47 to A11 (A11-A47 Connector Road) directing traffic away from Thickthorn junction and reducing pressure on these approaches. Once road users have left the main carriageway, both link roads will allow merge and diverge to and from the A47 or A11 without the need to stop.
- 4.2.2. The Scheme would sever the existing access between Cantley Lane South and Thickthorn junction, to enable the construction of the link road between the A47 and the A11, so that traffic is segregated from the junction and allow the main traffic to

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<sup>8</sup> [https://highwaysengland.citizenspace.com/he/a47-a11-thickthorn-junction-improvement-scheme/supporting\\_documents/Scheme%20assessment%20report%202018.pdf](https://highwaysengland.citizenspace.com/he/a47-a11-thickthorn-junction-improvement-scheme/supporting_documents/Scheme%20assessment%20report%202018.pdf)

flow through the junction. A new link road between Cantley Lane South and the B1172 Norwich Road to the north will be constructed, to reinstate this access.

- 4.2.3. The proposed A11-A47 Connector Road has been positioned to minimise the potential impact predicted on existing infrastructure and environment. The chosen route of the proposed connector road has minimised impacts, for example, removing the need to widen existing bridges, demolishing existing buildings, moving power lines and avoiding impacts on the Two Tumuli in Big Wood Scheduled Monument.
- 4.2.4. The A11-A47 Connector Road will include the provision of a maintenance layby and require the construction of three new underpasses and one new overbridge.
- 4.2.5. The proposed Cantley Lane South to B1172 Norwich link road (Cantley Lane Link Road) has been positioned to minimise the potential impact predicted on existing infrastructure and environment. The chosen route of the new link road has minimised impacts, for example, demolition of existing properties and the removal of veteran trees.
- 4.2.6. The new Cantley Lane Link Road would curve west-northwest before first crossing the A11 main carriageway and A11-A47 Connector Road via two new overbridges. The new road curves north before joining the B1172 to the west of Thickthorn junction.
- 4.2.7. The existing access to Cantley Lane South (from the existing A47 westbound exit slip road) would be removed and all Cantley Lane South traffic to and from Thickthorn junction will use the new link road to reach the B1172, A11 and A47.
- 4.2.8. A new turning head would be provided at the northern terminus of Cantley Lane South
- 4.2.9. The new link road would require the existing Cantley Stream to be realigned by approximately 550m. The adjacent access track would also be diverted south of the Cantley Stream realignment, but within the same land parcel.
- 4.2.10. Further details can be found on the General Arrangement Plans (**TR010037/APP/2.2**).

### **4.3. Drainage Design**

- 4.3.1. Flood risk and drainage design considerations are explored in Chapter 13 Road Drainage and the Water Environment of the ES (**TR010037/APP/6.1**).
- 4.3.2. A Flood Risk Assessment (FRA), (Appendix 13.1 of the ES (**TR010038/APP/6.3**)), was undertaken in accordance with the requirements of the NPS NN paragraphs 5.90 to 5.115, National Planning Policy Framework 2019 and the Environment Agency's climate change allowances.
- 4.3.3. A drainage strategy, (Appendix 13.2 of the ES (**TR010038/APP/6.3**)), was undertaken by in order to outline the proposed drainage design and mitigation measures to reduce impacts upon the water environment by the Scheme.
- 4.3.4. As part of the drainage strategy (Appendix 13.2 of the ES (**TR010037/APP/6.3**) and FRA (Appendix 13.1 of the ES) a detailed hydrological and hydraulic assessment was undertaken to establish the location and sizing of culverts required to convey surface flow pathways where these pathways are intersected by the Scheme. This has been undertaken in accordance with the requirements of Norfolk County Council, as the

Lead Local Flood Authority.

- 4.3.5. Section 3.8 of this Report outlines how the Scheme drainage design catered for increased surface water runoff and river flow predictions due to climate change. The drainage system has been designed in accordance with DMRB '*CG 501 Design of highway drainage systems*'.

## 5. STRUCTURES DESIGN

- 5.1.1. The Scheme includes a variety of new, modified, existing, demolished and replaced structures. These include underpasses, bridges, retaining walls and culverts that are detailed in the following sections.
- 5.1.2. The modified and new structures have been designed in accordance with current good practice and to comply with Department of Transport approved design standards; for example, DMRB *CD 127 'Cross-sections and headrooms'* and DMRB *'CD 143 Designing for walking, cycling and horse-riding'*. These fulfil the following Scheme criteria:
- provide highway clearances, headrooms and loading requirements
  - provide WCH requirements
  - comply with the requirements of third-party stakeholders where relevant.
- 5.1.3. All structures have been designed to ensure durability requirements are met but will also ensure materials are used efficiently. Structural concrete will incorporate a cement replacement combination mix to reduce the amount of cement and therefore reduce the associated embodied carbon of the structure.
- 5.1.4. The following sections describe the design considerations for the modified and proposed structures. The structures are illustrated on the General Arrangement Plans (**TR010038/APP/2.2**) and Engineering Drawing and Sections (**TR010038/APP/2.7**).

### 5.2. Underpass Design

- 5.2.1. The existing Cantley Stream underpass carrying the A11 over Cantley Stream would be extended, as part of the Scheme, to accommodate widening is for the diverge of the A11-A47 Connector Road from the A11 northbound. The proposed extension will match the existing in appearance.
- 5.2.2. The Ward's Wood underpass would convey the new A11-A47 Connector Road under the existing A11 dual carriageway as part of the Scheme.
- 5.2.3. Two different construction methods were considered for assessment:
- integral bridge: comprised of precast concrete deck beams with mass concrete in-fill and bored contiguous pile wall abutments
  - reinforced concrete box: constructed offline and launched into position within a deep excavation and backfilled.
- 5.2.4. The reinforced concrete box was the recommended structural option for Ward's Wood underpass. This option provides environmental benefits due to a shorter construction time, which results in less NO<sub>x</sub>, greenhouse gas emissions in the form of CO<sub>2</sub>, noise pollution and dust emissions.
- 5.2.5. The Cantley Lane underpass would convey the new A11-A47 Connector Road under the existing A47 dual carriageway. Five options were considered for the new Cantley Lane underpass. Three were discounted due to higher health & safety risks associated with the type and duration of the construction. These options also caused greater disruption to the road network due to the longer construction time.
- 5.2.6. Two different construction methods were considered for assessment:

- integral bridge: comprised of precast concrete deck beams with mass concrete in-fill and bored contiguous pile wall abutments
- reinforced concrete box: constructed offline and launched into position within a deep excavation and backfilled.

5.2.7. The reinforced concrete box was also the recommended structural option for Cantley Lane underpass. This option provides environmental benefits due to a shorter construction time, which results in less NO<sub>x</sub>, greenhouse gas emissions in the form of CO<sub>2</sub>, noise pollution and dust emissions.

### 5.3. Overbridge Design

5.3.1. The Cantley Wood overbridge would convey the new Cantley Lane Link Road over the A11 carriageway as part of the Scheme.

5.3.2. Four options were considered for the new Cantley Wood overbridge. Two options were discounted as they would require significant groundwork adjacent to the existing A11, which would lead to a longer construction period, greater cost and greater disruption to the road network.

5.3.3. Two different construction methods were considered for assessment:

- precast prestressed concrete beam composite: with in-situ reinforced concrete slab with reinforced concrete abutment and piled foundation
- steel beam composite: with in-situ reinforced concrete slab with reinforced concrete abutment and piled foundation.

5.3.4. Steel beam composite was discounted as it was found to be the least cost effective, had a longer design and construction time, require greater maintenance and less environmentally friendly, as it would require more energy for production which would lead to a larger carbon footprint. Therefore, the precast prestressed concrete beam composite was the recommended option.

5.3.5. The Cantley Wood Link Road overbridge would be located immediately north of the new Cantley Wood overbridge. The Cantley Wood Link Road overbridge would carry the Cantley Lane Link Road over the new A11-A47 Connector Road.

5.3.6. Four options were considered for the new Cantley Wood Link Road overbridge. Two options were discounted as they would require significant groundwork adjacent to the existing A11 which would lead to a longer construction period, greater cost and greater disruption to the road network.

5.3.7. Two different construction methods were considered for assessment:

- precast prestressed concrete beam composite: with in-situ reinforced concrete slab with reinforced concrete abutment and piled foundation
- steel beam composite: with in-situ reinforced concrete slab with reinforced concrete abutment and piled foundation.

5.3.8. Steel beam composite was discounted as it was found to be least cost effective, had a longer design and construction time, less environmentally friendly and would require greater maintenance. Therefore, precast prestressed concrete beam was the recommended option for the Cantley Wood Link Road overbridge.

## 5.4. Footbridge Design

- 5.4.1. The existing Cantley Lane footbridge, crossing the A47 between Cantley Lane South and Cantley Lane, would be demolished as part of the Scheme. The footbridge would be replaced with a new Cantley Lane footbridge (Cringleford) approximately 200m east of the existing bridge location. The replacement bridge would be suitable for all WCH users, with approach ramps on earthwork embankments.
- 5.4.2. The bridge is to be a single span of approximately 60m and would form a superstructure of steel through truss with a paint protection system.
- 5.4.3. Two different construction methods were considered for assessment:
- Reinforced concrete with retained approach paths: the substructure would be a full height abutment with wingwalls with pile foundation to the west. To the east, the substructure would be a full height abutment and wing walls in the form of contiguous piles.
  - Reinforced concrete with proposed steel approach ramps. The main span substructure would be steel frame piers with additional supporting columns for the ramps. The piers and supporting columns would be founded on steel helical piles.
- 5.4.4. Reinforced concrete with retained approach paths was identified as the recommended option as the construction process would not be reliant on the completion of service diversions prior to commencement and it would require less maintenance during operation of the Scheme.

## 5.5. Culvert Design

- 5.5.1. No works are proposed, as part of the Scheme, to the Cantley Culvert and Cringleford Culvert.
- 5.5.2. A new culvert (Cantley Lane South culvert) would be required to carry the diverted Cantley Stream beneath the existing Cantley Lane South carriageway. The culvert will be a precast box section 6m wide x 2.5m deep with a variable depth soft bed up to 0.7m deep forming the stream bed.
- 5.5.3. Following hydraulic modelling it was determined that Cantley Stream would be diverted to maintain the existing floodplain area, minimise the length of the proposed culvert to provide a cost-effective solution and to provide sufficient construction area for the proposed link between Cantley Lane South and Norwich Road.
- 5.5.4. Further details on the flood risk modelling and assessment can be found in Chapter 13 Road Drainage and the Water Environment of the ES (**TR010037/APP/6.1**).

## 5.6. Other Structures

- 5.6.1. The Cringleford Railway Bridge carries the A47 dual carriageway across the Breckland railway line to the south-east of the Scheme. No works are required, as part of the Scheme, to Cringleford Railway Bridge to avoid impacting Network Rail's assets during construction.



## 6. ENVIRONMENTAL DESIGN

### 6.1. Context

6.1.1. This section presents an overview of the environmental considerations that have influenced the design of the Scheme. This section also demonstrates compliance with the several NPS NN design requirements, such as paragraphs: 5.20 to 5.38 (biodiversity and ecological conservation), 5.124 – 5.138 (cultural heritage), 5.144 to 5.161 (landscape and visual) and 5.186 – 5.200 (noise and vibration).

### 6.2. Embedded environmental mitigation

6.2.1. The Applicant's EIA team has worked closely with the Applicant's design team to ensure a joined-up approach throughout the assessment process. This method ensured that the majority of environmental mitigation measures were raised at an early stage as constraints and opportunities were identified and incorporated into the design. This resulted in various environmental mitigation measures being embedded into the Scheme design, such as:

- avoiding direct impacts on the Scheduled Monument (Two Tumuli in Big Wood)
- Cantley Stream realignment will retain similar length, gradient and water depth to remain suitable habitat for water voles
- Cantley Lane South culvert will include a mammal shelf to allow continued passage for mammals.

### 6.3. Landscape Masterplan Design Considerations

6.3.1. As set out in Section 2 of this Report, Thickthorn junction lies adjacent to and encompasses the existing A47 near the settlements of Cringleford and Hethersett, west of Norwich. This is a lowland agricultural area, characterised by medium scale rectilinear fields bound by hedgerows and linear belts of trees. Intwood Hall is a Grade II\* listed RPG and is enclosed by woodland and located at the eastern extent of the DCO boundary. Thickthorn Hall is an RPG at County level and extends eastwards towards the Thickthorn Park and Ride site.

6.3.2. The environmental design seeks to integrate the Scheme with surrounding landscape character, minimise visual intrusion, and, wherever possible, preserve the informal rural character of the landscape away from the trunk road infrastructure. The Scheme includes retaining notable extents of existing planting and proposes new planting to replicate existing features and establish visual screening. Mitigation measures also seek to reinstate landscape features lost as a result of the Scheme, such as hedgerow boundaries and plantation woodland, as well as general enhancement of the landscape context wherever possible. The proposed landscape planting design is presented in the Environmental Master Plan (**TR010037/APP/6.8**).

6.3.3. The design seeks to integrate the Scheme with the existing landscape as follows:

- making it environmentally sustainable, retaining the sense of openness where this is consistent with a balanced preference for visual screening
- integrating the Scheme's infrastructure (notably elevated overbridges) through appropriate use of planting to contribute to visual screening

- reinforcing existing plantation character with woodland planting where this is consistent with the surroundings
  - reinforcing existing field boundaries with individual trees and hedgerows where the field pattern is a notable component of the landscape
  - retaining or replacing and reinforcing existing vegetation where this contributes to the distinctive qualities of the landscape
  - selecting plant and grass species appropriate to the locality to maintain consistency with the appearance of the area.
- 6.3.4. As set out in Chapter 7 Landscape and Visual of the ES (TR010037/APP/6.1) the assessment acknowledges the character of existing vegetation, which typically consists of field boundary hedgerows with individual trees, and woodland plantations.
- 6.3.5. The Scheme seeks to provide a landscape design that:
- provides appropriate visual, landscape, ecological and environmental mitigation whilst minimising land take and impact upon adjoining agricultural land
  - establishes new planting to screen and integrate the Scheme into the landscape, whilst retaining visual cohesion with existing landscape features
  - uses new planting to integrate the scale, layout, form and massing of the Scheme, to reduce the scale of earthworks and structures and filter views, as well as reinforce existing planting.
- 6.3.6. This proposed planting in the environmental design takes reference from the native plant species found in the surrounding area. Species include pedunculate oak (the prevalent species along field boundaries at Cantley Lane South and within remnant parkland areas near Thickthorn Hall), goat willow, hazel, cherry, hawthorn, blackthorn and field maple. The inclusion of diversity within planting mixes will embed an aspect of resilience and adaptation for vegetation faced with increasing pest, disease and climate change threats. The proposed planting also acknowledges the character of existing vegetation, which typically consists of informal field boundaries with individual trees and woodland areas.
- 6.3.7. The various Scheme planting types are consistent with DMRB defined elements<sup>9</sup> and compatible with standard highway practices for long term operational maintenance and management. The ultimate outcome of using locally occurring native species, which replicate existing features, and which are maintained in a manner consistent with that of the wider highway network will contribute to consistency and integration of the Scheme with its surroundings.

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<sup>9</sup> Broad classification types of component parts of the landscape with specific requirements or management needs to achieve their longer-term objectives. See <https://www.standardsforhighways.co.uk/prod/attachments/82073bde-ec0c-4d4f-8eeb-afe0ace3c639?inline=true>

## 7. INTER-RELATIONSHIP WITH OTHER MAJOR DEVELOPMENTS

- 7.1.1. This section sets out how the Applicant has engaged with and will manage the interaction with the following major developments directly interacting with the Scheme, which in turn influenced the design and construction strategy for the and assumptions set put in the ES (TR010037/APP/6.1):
- Cringleford Housing Development<sup>10</sup>
  - Orsted's Hornsea Project Three Offshore Wind Farm<sup>11</sup>
  - Vattenfall's Norfolk Boreas<sup>12</sup> and Norfolk Vanguard<sup>13</sup> offshore wind farms.
- 7.1.2. Cringleford Residential Development is an approved new large residential housing development by Big Sky Living and located adjacent to the south-east corner of the Scheme. Construction commenced on its first phase of 60 houses in May 2020, with the first residential properties due to be ready in early 2021. There will be a variety of apartments, bungalows and houses with 1 to 5 bedrooms available to buy or rent. In total, 350 new houses will be built here.
- 7.1.3. The Applicant has worked closely with Big Sky Living to ensure the Scheme design does not compromise the Cringleford Residential development, with design changes as result including:
- removing a construction access haul route for the Scheme from the A11, east of the junction, through the Cringleford Residential development area
  - relocating the Scheme's drainage and attenuation pond to retain the drainage and wetland habitat provision proposed by the Cringleford Residential development
  - designing the statutory utility diversion works in the corridor between the A47 and Cringleford Residential Development so as not to prevent Big Sky Living delivering on its commitment to provide a minimum area of public open space.
- 7.1.4. Orsted's Hornsea Project Three proposes a new offshore wind farm off the north Norfolk coast. The consented onshore cabling connection route to National Grid substation passes west of the Thickthorn junction, between the Scheme and the main construction compound located at Station Road.
- 7.1.5. There would be no direct interaction between the Scheme and the offshore wind farm, but the construction programmes will overlap during 2023 and 2024. Therefore, the Applicant will work with Orsted through regular meetings and exchange of information, under a Non-Disclosure Agreement, during the respective detailed design and construction stages. In this way the Applicant will manage construction traffic management to minimise cumulative effects and schedule key activities not to adversely affect each other.

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<sup>10</sup> <https://www.bigsky-living.com/new-homes-for-sale/st-giles-park-cringelford/>

<sup>11</sup> <https://infrastructure.planninginspectorate.gov.uk/projects/eastern/hornsea-project-three-offshore-wind-farm/>

<sup>12</sup> <https://infrastructure.planninginspectorate.gov.uk/projects/eastern/norfolk-boreas/>

<sup>13</sup> <https://infrastructure.planninginspectorate.gov.uk/projects/eastern/norfolk-vanguard/>

- 7.1.6. Vattenfall's Norfolk Boreas and Norfolk Vanguard proposes new offshore wind farms off the north Norfolk coast, with onshore cabling crossing the A47 west of Dereham and a new substation connecting into the A478 west of Dereham. Following an Order of the High Court made on 18 February 2021, the decision of the Secretary of State dated 1 July 2020 to grant the application by Norfolk Vanguard Limited for development consent for the proposed Norfolk Vanguard Offshore Wind Farm has been quashed. The Secretary of State is considering the judgment and will decide on the next steps in due course, however this has still to be considered.
- 7.1.7. There would be no direct interaction with the Scheme, but the construction programmes will overlap during 2022 to 2024. Vattenfall will import material from overseas via ports in Great Yarmouth or Lowestoft, and the materials will pass through the Scheme. Some of these loads will include large abnormal deliveries, such as 80m long low loaders with new electricity substation transformers.
- 7.1.8. The Applicant has agreed to work with Vattenfall through regular meetings and exchange of information during the respective detailed design and construction stages. This will enable Vattenfall and the Applicant to manage construction traffic and schedule major works on the Scheme to avoid clashing with major delivery movements for the Norfolk Boreas and Norfolk Vanguard developments. These discussions will continue with Vattenfall despite the recent High Court decision on the North Vanguard Offshore Wind Farm DCO.

## 8. STATUTORY UNDERTAKER (UTILITIES) CONSIDERATIONS

8.1.1. Table 8-1 below summarises the Statutory Undertakers' apparatus, some of which would be directly affected by the Scheme.

Table 8-1: Statutory undertakers apparatus affected by the Scheme

Statutory Undertaker	Asset Type	Affected Asset
Anglian Water	Water	A number of clean and wastewater assets impacted within Cantley Lane and a gravity surface water sewer along the A11, requiring diversion of the affected assets. Also, a foul sewer that crosses both the A11 and A47 that likely requires protection works.
BT Openreach	Telecoms	Network cabling within Norwich Road, which is likely to be a main fibre cable route and within Cantley Lane, which is local network apparatus.
Cadent	Gas	Low pressure main & customer supplies affected within Cantley Lane.
GTC	Electricity	11kV network (TBC if adopted by UKPN) within Norwich Road, not expected to be adversely affected by the works.
Highways England (Technology equipment)	Traffic Cameras	Three ANPR camera locations to removed.
Orange, T-Mobile & Network Rail.	Mobile Mast Transmitter	Three mobile mast sites have been identified within close proximity to the Scheme; one mast directly impacted by the construction activities and to be removed or relocated.
MOD (GPSS)	Fuel pipeline	Abandoned fuel pipeline within proximity of the works, but not directly affected by the construction activities.
National Grid – (NGET)	Electricity	National Grid Electrical Transmission 400kV overhead lines & towers cross the Scheme. Measures to maintain access & minimum safe clearance to be incorporated into the design. This commitment is set out in the EMP (TR010037/APP/7.4).
Network Rail	Transport infrastructure & communications mast	There are no works required for the Scheme within Network Rail land boundaries. The communications mast unlikely to be affected by the works.
UKPN	Electricity (132kV to LV, buried cables and overhead lines)	Strategic network assets affected by the Scheme, 132kV buried cable north of the A47 & 33kV overhead lines between the A11, A47 & Cantley requiring diversions. Alterations to the 11kV and LV networks required within Cantley Lane north and south.
Virgin Media	Fibre-optic telecoms	Strategic national network 96 no. fibre optic cable to be diverted from the A47 verge.
Vodafone	Fibre-optic	Existing apparatus affected at the proposed Cantley

Statutory Undertaker	Asset Type	Affected Asset
	telecoms	Lane Link Road junction on the B1172 Norwich Road.

- 8.1.2. The following sections explore the options considered to manage the impacts on the utility assets described in the above table, along with the key consultations, environmental constraints, technical and safety requirements.
- 8.1.3. These considerations determine the method, route and extent of works to relocate or alter these assets and have in turn influenced the DCO boundary and assumptions in the ES (**TR010037/APP/6.1**).
- 8.1.4. Engagement with the statutory undertakers continues, further refining the detailed designs, construction methods and programme for creating new or diverting existing utility assets.

## 8.2. Anglian Water

- 8.2.1. A number of Anglian Water potable water mains and sewers will be affected by the Scheme. Preliminary diversion options have been discussed and indicative routes agreed.
- 8.2.2. A 300mm diameter surface water sewer within the west verge of the A11 clashes with the box structure for the proposed Ward's Wood underpass. Detailed investigations are required to determine the existing levels to confirm if the sewer can be accommodated within the box structure on its existing alignment after the works are complete. If the sewer needs to be diverted then a long alternative diversion route has been identified within the DCO boundary, but further information is required to determine the existing ground levels along this route.
- 8.2.3. Existing 4- and 8-inch diameter water mains cross the existing A47 from Cantley Lane North to Cantley Lane South where they join to become a single 8-inch diameter main. These two mains are proposed to be diverted within the multi-utility corridor (shared with UKPN, Cadent Gas and BT Openreach) and would be twinned under the A47 within sleeves. There are opportunities to simplify this design and the Applicant is working with Anglian Water to consider removing the twinned mains as well as possibly combining both the mains into one larger main. A short diversion of the single 8-inch diameter main is also required further south along Cantley Lane.
- 8.2.4. A 225mm diameter foul gravity sewer runs from west to east all the way along the route of the watercourse north of the railway line and there are several locations where protection measures over this sewer may be required. At this stage Anglian Water have not proposed any diversions, but there is one conflict location with a proposed culvert for the watercourse within Cantley Lane South. This is currently proposed by Anglian Water to remain in-situ; however, a short alternative diversion route has been identified for the sewer in case diversion is required once more detailed level information is known.
- 8.2.5. Other existing assets are present, but are not expected to be significantly affected by the construction activities:
- two gravity sewers cross under the existing A47 to the west near the Scheme boundary

- a 90mm diameter water main located within the northern verge of the existing B1172 Norwich Road
- other sewers located within or near the works but not expected to be affected by any construction activities.

8.2.6. On-going discussions with Anglian water and site investigations are required to determine the potential impact construction activities may have on all the assets. An impact plan will be developed by Anglian Water to ensure contingency arrangements are in place in case of an incident during construction<sup>14</sup>.

8.2.7. Safe digging practices and suitable permitting will be applied during the works, along with thorough site investigations prior to the works, as non-intrusive survey methods seldom manage to locate plastic mains. These commitments are set out in the Environmental Management Plan (EMP) (**TR010037/APP/7.4**).

### **8.3. BT Openreach**

8.3.1. BT Openreach underground and overhead network apparatus is present within Cantley Lane North and South, as well as a 9-way duct route within the southern verge of the existing B1172 Norwich Road.

8.3.2. BT Openreach propose to retain the existing 9-way ducts within the verge, demolish the existing manhole and jointing chamber, then bypass with new a 4-way duct route and new chambers.

8.3.3. The overhead lines within Cantley Lane South are proposed to be replaced with buried cables, but discussions continue with Openreach to divert with new overhead lines and poles where possible.

8.3.4. The existing duct crossing of the A47 is to be diverted via the multi-utility diversion corridor (shared with Anglian Water, UKPN and Cadent Gas). BT Openreach ducts and chambers are to be installed adjacent to the pond access track, providing BT Openreach with suitable access to their chambers.

### **8.4. Cadent Gas**

8.4.1. A Cadent Gas 125mm low diameter pressure gas main currently crosses the existing A47 from Cantley Lane North to Cantley Lane South. The existing alignment clashes with the proposed Cantley Lane underpass.

8.4.2. Discussions are ongoing with Cadent to finalise a diversion via the multi-utility diversion corridor (shared with Anglian Water, UKPN and BT Openreach) to the east of the current road crossing.

8.4.3. Safe digging practices and suitable permitting will be applied during the works, along with thorough site investigations prior to the works, as non-intrusive survey methods seldom manage to locate plastic mains. Cadent Plant Protection will be advised of any construction activities within close proximity of their assets.

### **8.5. GTC (Electrical)**

8.5.1. A pair of 11kV cables are shown on GTC's records within the northern verge of the existing B1172 Norwich Road, along the same alignment as a UKPN cable. There is

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<sup>14</sup> Protected provisions are not appropriate here and this type of arrangement is to be dealt with by a side agreement with Anglian Water if required.

only likely to be one pair of cables, so these may have been adopted by UKPN from GTC; this will be confirmed with both parties. It is currently not anticipated that these cables will require diverting.

## **8.6. Mobile Mast Transmitters**

- 8.6.1. Three mobile mast transmitter sites have been identified within proximity of the Scheme. The mobile mast within Cantley Lane north (formerly Orange, now EE), clashes with the A11-A47 Connector Road earthworks, adjacent to the Cantley Lane underpass.
- 8.6.2. Investigations are on-going to determine whether the Orange mobile mast requires relocating and if any elevated elements of the Scheme, cast a shadow on the transmitter transmission area. Further engagement with the mast management organisation will confirm this.
- 8.6.3. The two other mobile masts identified are not expected to be affected by the Scheme. Further investigations are ongoing to confirm whether any elevated elements of the Scheme cast a shadow on the transmission areas, which could result in the height of the masts being altered or the masts being relocated. Further engagement with the individual mast management organisations will confirm this.

## **8.7. Ministry of Defence (abandoned fuel line)**

- 8.7.1. An abandoned Ministry of Defence (Government Pipelines and Storage System) fuel line crosses the existing A11 east of the Station Lane junction alterations, from an abandoned depot. The pipeline is not expected to be affected by the works, but there may be the risk of localised contamination of the area.

## **8.8. National Grid**

- 8.8.1. National Grid Electrical Transmission 400kV overhead lines cross the existing A11 close to the proposed Ward's Wood underpass and continue south-eastward, crossing over Cantley Lane South.
- 8.8.2. The Scheme earthworks design has been altered to maintain the minimum safe height clearances and working room for site plant movements to avoid the need for diversion. Maintenance access to the towers will be maintained for National Grid throughout the works and on completion of the Scheme.
- 8.8.3. All construction activities and plant movements within close proximity of the overhead lines will be undertaken in accordance with standard safety protection measures and as agreed with the National Grid Plant Protection Team.

## **8.9. Network Rail**

- 8.9.1. No Network Rail assets have been identified outside their land boundary and none are affected by the Scheme. A communications mast is located to the south of the Scheme within the Network Rail land.
- 8.9.2. It is unlikely that any elevated elements of the Scheme will cast a shadow on the transmitter transmission area.

## **8.10. UKPN 132kV**

- 8.10.1. A UKPN high voltage 132kV circuit (three cables and two pilots) runs parallel with the existing A47 and clashes with the proposed Cantley Lane underpass.



- 8.10.2. Engagement with UKPN and the developer (Big Sky), north of the A47 has enabled the Applicant to agree a diversion route with UKPN. The agreed route maintains UKPN easement requirements, while moving the cable away from construction activities and providing space for a proposed multi-utility diversion corridor under the A47.
- 8.10.3. Discussions are on-going to potentially programme the diversion in advance of the main works. The cable circuit is subject to seasonal outage restrictions from April to October. These works will need to be planned by UKPN before the DCO decision and the on-going review of the construction programme is required to confirm if the diversion will need to be completed before or after the DCO decision. Any diversion works ahead of the DCO Decision would be undertaken through the use of UKPN's Permitted Development Rights.
- 8.11. UKPN 33kV Overhead Cables**
- 8.11.1. 33kV overhead cables cross the Scheme from the south over the railway line, heading north-west over Cantley Lane South and across the A11, west of the Thickthorn junction roundabout.
- 8.11.2. The initial proposal by UKPN consisted of an approximately 1km diversion, including horizontal direction drilling (HDD) under the A11 and works outside the Scheme boundary. As a result of engagement with UKPN, this option was discounted. Six alternative routes were considered and it was agreed that the affected section of overheads could be reduced to a shorter length diversion within the Scheme boundary, between the A11 and Cantley Lane.
- 8.11.3. Discussions are on-going to finalise this route and determine whether the route will use HDD or will be open cut. The diversion will also be subject to similar seasonal restrictions as the 132kV diversions, so planning will need to be progressed before the DCO decision and the diversion may also need to commence prior to the DCO decision. Any diversion works ahead of the DCO Decision would be undertaken through the use of UKPN's Permitted Development Rights.
- 8.11.4. A second diversion of the overheads to the south of Cantley Lane was avoided by agreeing to move the proposed landowner access for Meadow Farm Cottage southward, removing a complicated and potentially expensive diversion.

## **8.12. UKPN 11kV and Low Voltage Network**

- 8.12.1. UKPN's low voltage network conflicts with the works within Cantley Lane North and South and discussions are ongoing to finalise diversion requirements.
- 8.12.2. Their buried high voltage 11kV crosses the existing A47 will be diverted via a multi-utility diversion corridor (shared with Anglian Water, Cadent Gas and BT Openreach) and the 11kV overhead line will be removed to the north.
- 8.12.3. UKPN's records show a pair of 11kV cables located within the northern verge of the existing B1172 Norwich Road, along the same alignment as a GTC cable. There is only likely to be one pair of cables, so these may have been adopted by UKPN from GTC; this will be confirmed with both parties.
- 8.12.4. All construction works near electricity lines will be undertaken in accordance with standard safety protection measures and following consultation with the plant protection section of the asset owner.

## **8.13. Virgin Media**

- 8.13.1. A Virgin Media strategic national network 96 fibre-optic cable is present in the verge of the existing A47. It is also believed this cable continues along the A47 and through the Scheme.
- 8.13.2. Discussions are ongoing with Virgin Media to divert the existing duct route. The initial diversion proposal by Virgin Media clashed with the Cantley Lane underpass, It has been agreed to divert their two-way ducts and fibre along the multi-utility diversion corridor to the north of the A47. This will follow the A47 northern verge and the internal perimeter of the Thickthorn junction roundabout. This will avoid the carriageway widening on the southern side of the roundabout.
- 8.13.3. The strategic importance of this cable restricts any outages (switchovers) to only one outage in any 12-month period. The programming of these works will also need to be coordinated with construction of the Scheme.

## **8.14. Vodafone**

- 8.14.1. On-going discussions continue with Vodafone to confirm the diversion requirements for their ducts within the southern verge of the B1172 Norwich Road, where they clash with the proposed new junction of the Cantley Lane Link Road.
- 8.14.2. The ducts are currently proposed to be diverted, however there may be an opportunity to slew and lower these cables. This would remove the requirement for cable outages, reducing programme and costs, and is currently being discussed with Vodafone.

## 9. CONSTRUCTION CONSIDERATIONS

### 9.1. Introduction

9.1.1. This section explores the key issues and decision-making that determined the location and extent of the following construction features, which in turn influenced the DCO boundary and assumptions in the ES (**TR010037/APP/6.1**):

- site compounds
- material storage and handling areas
- work areas to build the Scheme
- construction traffic management
- construction work area requirements.

### 9.2. Site Compounds

#### Overview

9.2.1. Table 9-1 below summarises the proposed site compounds which are required on a temporary basis to facilitate the construction of the Scheme. The locations and extent of the compounds are shown on the Works Plans (**TR010037/APP/2.4**).

9.2.2. In addition to these larger compounds, minor temporary compounds (approximately 1,000m<sup>2</sup>) will serve construction of permanent works at outlying locations throughout the DCO boundary. These minor compounds will contain welfare facilities, small offices, plant, equipment and materials storage.

9.2.3. Development of compound proposals have taken place to account for the requirements of the construction works, and in particular the location of the new structures, junctions and major utility diversions. The presence of local community receptors and environmental constraints have also been accounted for in the planning of the compound areas. Feedback from landowners has also been factored into the selection and extent of the compound locations.

9.2.4. It is estimated there would be approximately 100 employees permanently on site with an expectation of 10% visiting staff. It is currently expected that a ratio of permanent employees to other personnel, including personnel from supply chain partners, statutory authorities and support functions, of 1:5 is likely. This would result in a peak expectation of around 550 people on site. The construction compound requirements are based on this.

Table 9-1: Proposed temporary site compounds

Compound number	Approximate area (m <sup>2</sup> )	Purpose and justification	Access arrangements	Further details
1	34666	Satellite construction compound and material storage, management and processing area east of A11 and north of the scheduled monument (Two Tumuli in Big Wood).	Off Cantley Lane South, through field to North of Big Wood	Shown as Work No. 30 and Work No 31 on the Works Plans (TR010037/APP/2.4) and within Schedule 1 of the Draft DCO (TR010037/APP/3.1).
2	23875	Main Construction compound south-west of the new Norwich Road and Cantley Lane Link Road junction.	Off Norwich Road with access to be gained via new Cantley Lane Link Road.	Shown as Work No. 3 on the Works Plans (TR010037/APP/2.4) and within Schedule 1 of the Draft DCO (TR010037/APP/3.1).
3	16248	Satellite Construction and traffic management compound south-east of the new Norwich Road and Cantley Lane Link Road junction.	Off Norwich Road with access to be gained via new Cantley Lane Link Road	Shown as Work No. 5 on the Works Plans (TR010037/APP/2.4) and within Schedule 1 of the Draft DCO (TR010037/APP/3.1).

### **Compound 1 – satellite compound & material storage & processing area**

- 9.2.5. Compound 1 (Work No 30) and material storage & processing area (Work No 31) has been located centrally to the Scheme and will support the construction of the main elements, including Wards Wood underpass, Cantley Lane underpass, Cantley Wood overbridge and Cantley Wood Link Road overbridge, and ancillary elements of the Scheme (e.g. Cantley Lane South Culvert, attenuation pond, etc.).
- 9.2.6. Given the relatively compact footprint of the Scheme and the juxtaposition of the key elements as listed, the central location proximal to the construction works will allow for more efficient construction and reduced impact during construction.
- 9.2.7. The compound has been sized to allow sufficient space for:
- parking and welfare facilities
  - satellite Office and supply chain partner offices
  - storage of plant, equipment and materials
  - concrete washout and vehicle washdown facilities
  - delivery vehicle stacking and waiting facilities
  - materials storage and processing area, including cement bound granular material (CBGM) batching plant, used in conjunction with the compound (Work No 31)
- 9.2.8. The compound is located within vacant farmland north of Big Wood and access shall be gained from the north via an access track constructed off Cantley Lane South and across the field. The location of the compound has considered the following receptors, but these are not deemed to be sufficiently close to the proposed compound area to be affected. However, due consideration of any impact will be taken into consideration in the detailed planning and construction of the compound:
- Big Wood to the south and east
  - Two Tumuli in Big Wood Scheduled Monument to the south east and south west
  - residential dwellings fronting Cantley Lane South beyond Big Wood
- 9.2.9. Other factors that will be considered in the detailed planning and construction of the compound include:
- local traffic management and minor carriageway improvements around the proposed access off Cantley Lane South
  - control of compound surface water drainage and run-off to minimise off-site impacts pursuant to Environmental Management Plan (EMP) (TR010037/APP/7.4) requirements
  - siting of noise and light emitting equipment
  - siting of temporary materials storage (topsoil) to provide screening.

### **Compound 2 – main construction compound**

- 9.2.10. Compound 2 shall provide the principal construction compound for the Scheme and is located south-west of the proposed new B1172 Norwich Road and Cantley Lane Link Road junction. Access shall be gained off Norwich Road via new Cantley Lane

Link Road. This compound is expected to serve as the main hub for the Scheme and as such has been sized to accommodate approximately 350 people and shall provide space for:

- parking and welfare facilities
- employer, contractor and supply chain partner office facilities
- site reception and induction
- medical facilities
- storage of high value plant, equipment and materials.

- 9.2.11. The compound is located on open and vacant farmland south of the B1172 Norwich Road and west of the existing Thickthorn Park and Ride facility and proposed extension. The compound has considered potential impact on the adjacent receptors which comprise existing wooded areas to the north and west and impact is considered to be minimal.
- 9.2.12. Other factors that will be considered in the detailed planning and construction of the compound include:
- local traffic management and minor carriageway improvements around the proposed access off Cantley Lane South
  - control of compound surface water drainage and run-off to minimise off-site impacts pursuant to EMP (TR010037/APP/7.4) requirements
  - siting of noise and light emitting equipment
  - siting of temporary materials storage to provide screening.
- 9.2.13. It is noted that there is a veteran tree located within the proposed compound area and this will be retained, protected and sympathetically included within the detailed design and construction of the compound.

### **Compound 3 – satellite compound and traffic management compound**

- 9.2.14. Compound 3 will provide additional and satellite facilities to the main construction compound (Compound 2) and will also provide the hub for traffic management facilities for the Scheme as a whole. This satellite compound would be located adjacent and to the east of the main compound (Compound 2) and south-east of the proposed new Norwich Road and Cantley Lane Link Road junction. Access shall be gained off Norwich Road via new Cantley Lane Link Road.
- 9.2.15. The compound has been sized to provide space for additional construction support and will include:
- parking and welfare facilities
  - satellite Office and supply chain partner offices
  - storage of plant, equipment and materials
  - concrete washout and vehicle washdown facilities
  - delivery vehicle stacking and waiting facilities
- 9.2.16. In addition, as the hub for traffic management facilities the compound will also include dedicated support facilities including:

- the storage of traffic management equipment and vehicle requiring 24hr access
- recovery vehicle and accommodation, including emergency vehicle refuge
- 24hr welfare facilities
- parking and welfare facilities

9.2.17. The compound would be located on open and vacant farmland south of Norwich Road and west of the existing Thickthorn Park and Ride facility and proposed extension. The location is expedient for access to the existing road network in respect of implementation and maintenance of traffic management during construction. The compound has considered potential impact on the adjacent receptors which comprise existing wooded areas to the north and west and impact is considered to be minimal.

- 9.2.18. Other factors that will be considered in the detailed planning and construction of the compound include:
- local traffic management and minor carriageway improvements around the proposed access off Cantley Lane South
  - control of compound surface water drainage and run-off to minimise off-site impacts pursuant to EMP (TR010037/APP/7.4) requirements
  - siting of noise and light emitting equipment
  - siting of temporary materials storage to provide screening.

### **9.3. Material Storage, Management and Processing Areas**

9.3.1. Table 9-2 below summarises the proposed areas designated for material storage, management and processing which are required on a temporary basis and as part of the earthworks and other activities to facilitate the construction of the Scheme. The locations and extent of these areas are shown on the Works Plans (TR010037/APP/2.4) and set out in Schedule 1 of the Draft DCO (TR010037/APP/3.1).

9.3.2. The designation of Compound 1, as described above, includes an area for materials storage, management and processing that is expected to be integrated with the compound and function in supporting the construction activity as part of the construction compound. As such and for the purposes of this Report, this area (listed as Work No. 31) is not detailed separately below. However, its selection, designation and use will follow that of the remainder of the materials storage, management and processing areas as detailed below.

Table 9-2: Proposed temporary material storage

Material area	Approximate area (m <sup>2</sup> )	Purpose and justification	Access arrangements	Further details
1	3588	Material storage, management and processing area south of the Thickthorn Park and Ride's.	Off the new Cantley Lane Link Road	Shown as Work No. 7 on the Works Plans (TR010037/APP/2.4) and within Schedule 1 of the Draft DCO (TR010037/APP/3.1).
2	13097	Material storage, management and processing area east of the A47 and south of Cantley Lane	Access to be formed off A47 and integrated with main works.	Shown as Work No. 32 on the Works Plans (TR010037/APP/2.4).and within Schedule 1 of the draft DCO (TR010037/APP/3.1)
3	18013	Material management, processing and storage area at Station Lane.	Access off Station Lane and integrated with main works	Shown as Work No. 44 on the Works Plans (TR010037/APP/2.4) and within Schedule 1 of the Draft DCO (TR010037/APP/3.1).
4	Included in plan area of compounds 2 and 3	Material storage only (topsoil) incorporated in linear bunds adjacent to compound area numbers 2 and 3.	Access through compounds numbers 2 and 3.	Shown as Work No. 4 and 6 on the Works Plans (TR010037/APP/2.4) and within Schedule 1 of the draft DCO (TR010037/APP/3.1).



- 9.3.3. The mainline highways works for the Scheme will involve earthworks associated with the construction and development of the designed alignment with excavation for cuttings and construction of the Wards Wood and Cantley Lane underpass structures, plus filling for embankments and realignment of the Thickthorn junction A11 to A47. In addition, there are earthworks relating to necessary and ancillary construction works, including smaller structures (culverts), drainage works, utilities and services placement and diversions, and various accommodation works required to support, enable and facilitate the mainline construction.
- 9.3.4. In addition to the construction related earthworks, there is a requirement to strip existing topsoil within the proposed extent of the Scheme to permit construction to be carried out. The topsoil is required for landscaping and restoration of the Scheme post construction. As such the topsoil will need to be stockpiled and managed appropriately to preserve and maintain the pedological characteristics and value in accordance with applicable standards and best practice.
- 9.3.5. Overall, the constructive earthworks and the topsoil stripping, when taken together, present a significant volume of materials to efficiently and expediently manage as part of the execution and delivery of the Scheme. Moreover, the distinctly different requirements for managing the topsoil from other earthworks materials imposes additional challenges and constraints on how the two broad material types need to be managed.
- 9.3.6. The Scheme will as far as practicable aim to deliver an earthworks plan (called earthworks mass-haul) whereby material export and import to construct the Scheme is balanced with volumes matched where possible. In addition, the topsoil stripped will be used within the Scheme landscaping and restoration, such that there is as far as possible no excess or shortfall.
- 9.3.7. This notwithstanding, whilst a material balance may be achieved, as far as practicable, carrying out the earthworks themselves will require appropriate mass-haul planning (economical movement and use of materials) and phasing of the mass haul linked to the construction programme to ensure efficient and effective earthworks delivery. Moreover, the development and subsequent execution of the mass-haul is predicated on having working space within the curtilage of the works for: handling and managing materials; marshalling the movement of soils within the works; temporarily stockpiling materials; and, if necessary, processing or conditioning the materials to render them suitable for use.
- 9.3.8. Pursuant to these requirements, the working spaces to be used within the Scheme for the materials management have been selected to meet one or more of the following criteria:
- Minimise as far as possible adverse environmental impact, and in this regard location in areas where any impact can be ameliorated as necessary.
  - Dedicated space which is, as far as possible, located outwith the immediate footprint of the permanent works and working areas so that the stockpiling, management and processing of the earthworks materials does not frustrate, restrict or prevent the efficient construction of the Scheme as programmed.
  - The size and shape of any area used for materials storage, management and processing must be suitable for the safe execution of the various activities

required, including access/egress linked closely to the main construction works, space for safe plant operation and movement, space for appropriate segregation of plant and personnel.

- The areas for materials storage, management and processing should provide sufficient space for stockpiling and processing commensurate with the nature of the materials concerned. This would mean the properties and characteristics of the materials are not impaired and rendered unsuitable.
- The materials storage, management and processing areas are located optimally to support the earthworks. In this regard the areas need as far as possible to be proximal to the main works to avoid excessive and inefficient haulage.

9.3.9. In addition to the general criteria to be satisfied for the materials storage areas, the generation of topsoil and the specific technical requirements that apply to the management and storage of topsoil impose additional requirements to have areas within the Scheme which are primarily and perhaps only used for managing topsoil. The specific technical requirements around topsoil management require additional areas to be defined for this specific use which may practically limit the storage of topsoil with other materials (e.g., restrictions on storage mound geometry or height, the need to ensure no over-compaction and loss of structure, avoiding cross-contamination and degradation in quality, safeguard against self-seeding). Also, given the construction sequence, dedicated topsoil storage areas will need to be preserved and maintained throughout the course of the works. For this reason, the linear storage bunds identified Material Area 4 in Table 9-2 may be predominantly used for this purpose.

9.3.10. The preliminary design and assessment of earthworks requirements and volumetric analysis for the Scheme are summarised in Table 9-3 below. This can be used to identify a quantum of areas needed for materials storage, management and processing. In particular, reference should be made to items 3, 6 and 7.

Table 9-3: Summary of principal earthworks volumes

	Material, Origin and Use	Estimated Volume (m <sup>3</sup> )
1	Topsoil from stripping within the Scheme to allow construction.	40,000
2	Topsoil identified for landscaping and Scheme restoration.	14,000
3	Surplus topsoil from stripping which will need to be retained and stockpiled pending incorporation into Scheme (if possible) or held pending alternative use.	26,000
4	Volume of general earthworks (non- topsoil) material to be excavated from within the Scheme.	270,000
5	Volume of earthworks for construction of the Scheme.	142,000

	Material, Origin and Use	Estimated Volume (m <sup>3</sup> )
6	Volume of site won material which may not be suitable for direct placement (i.e. out of specification or U1 Classification) and will require treatment to render it useable or otherwise retained pending use/disposal (excludes contaminated materials and materials classified as U2).	49,000
7	Volume of surplus general earthworks (non-topsoil) material which will require stockpiling pending alternative use.	79,000

- 9.3.11. Considering the storage and management of topsoil, the estimated volume involved (see items 1 to 3 in Table 9-3) is 40,000m<sup>3</sup>. If this is to be stockpiled temporarily or for the duration of the works assuming, a stockpile height not exceeding 2m (specification DMRB Series 600) and an assumed safe angle of repose for topsoil at 1V:2H is to be assumed. Therefore, the approximate area required for stockpiling with an allowance for working space is approximately 25,000m<sup>2</sup>.
- 9.3.12. With regard to the requirements for managing the materials required for constructive earthworks, it is considered that the expected working space needed for the management of earthworks materials excluding the topsoil is approximately 20,000m<sup>2</sup>. This assumes accepted construction best custom and practice, calibrated against specific and comparable schemes elsewhere, and related to phased construction, efficient execution and programme.
- 9.3.13. In summary, the areas identified for materials storage, management and processing provide in total an estimated functional working area of 40,000m<sup>2</sup> (see table 9-2). This is broadly balanced against the assessed spatial requirements as determined from the earthworks volumes.

#### 9.4. Construction Programme and Methods

- 9.4.1. The construction programme, phasing and methods are described in Chapter 2, The Proposed Scheme of the ES (**TR010037/APP/6.1**). The approach described is indicative, but it is representative of the likely approach to be adopted.
- 9.4.2. The ES (**TR010037/APP/6.1**) has considered the phasing sequences associated with two construction methods to install the underpasses under the A47 and A11: the box-push method and top-down method.
- 9.4.3. The final selection of the method of construction, box-push versus top-down, will be based on a multi-criteria assessment process to be defined and implemented at the commencement of detailed design. The decision will also consider the merits of each option holistically against a set of characteristics which will provide an objective and robust selection. The technical and engineering aspects of the two options will be an important consideration, in particular the:
- overall efficiency of the solution
  - relative feasibility of the method in the context of the site conditions
  - balance of construction risks

- track-record of successful delivery on comparable schemes
- assessed ability of the supply chain to expediently deliver the solution.

9.4.4. However, technical issues are not the only concern and the decision will be equally informed by issues relating to relative social and environmental impact, carbon credentials, community interface, delivery and impact of temporary works, programme, and cost.

#### **Box-push method**

9.4.5. This method would involve the following sequence of construction activities:

- utility diversions
- commence construction of new Cantley Lane footbridge (Cringleford) and preparatory earthworks for A11-A47 Connector Road and box push works
- offline construction of underpass boxes
- construction of Cantley Lane Link Road and A47 southbound merge slip
- complete Cantley Lane footbridge (Cringleford)
- push boxes into place to form Ward's Wood and Cantley Lane underpasses below A11 and A47 and reconstruct carriageways above
- construct A11-A47 Connector Road and on and off slip roads.

#### **Top-down method**

9.4.6. This method would involve the following sequence of construction activities:

- utility diversions and commence construction of new WCH bridge
- widen A11 to east side to carry traffic, allowing construction of the west side of the Ward's Wood underpass
- construction of Cantley Lane Link Road and A47 southbound merge slip
- complete the new Cantley Lane footbridge
- move A11 traffic to new west side lanes allowing construction of east side of the Ward's Wood underpass
- move A11 traffic to new east side lanes allowing construction of west side of the Ward's Wood underpass
- complete A11 and A47 works over both underpasses.

### **9.5. Construction Site Management**

9.5.1. An EMP (**TR010037/APP/7.4**) has been prepared to include construction, operational and maintenance good practice and mitigation measures. These have been identified in part by the assessments presented in the ES (**TR010037/APP/6.1**). The EMP includes the register of environmental actions and commitments (REAC).

9.5.2. In line with DMRB *LA 120 Environmental Management Plan*, the EMP establishes a suitable mechanism to link assessment assumptions, DCO Requirements and obligations. The EMP (**TR010037/APP/7.4**) is secured by Requirement 4 of the Draft DCO (**TR010037/APP/3.1**) and is a live document which will be revised as more

information becomes available throughout the lifetime of the Scheme.

- 9.5.3. The DCO application also contains an Outline Traffic Management Plan (**TR010037/APP/7.5**) that defines the measures used to reduce the impacts from construction traffic, such as reducing worker vehicle and HGV movements, particularly at peak periods. The Outline Traffic Management Plan is secured by Requirement 10 of the Draft DCO (**TR010037/APP/3.1**)
- 9.5.4. The construction traffic will be managed to limit noise and dust (as well as mud and the cleanliness of the local roads), in line with industry best practice. This will include the use of wheel washing and similar controls as set out in the EMP (**TR010037/APP/7.4**). Specific construction site management plans will be produced prior to the start of construction.

## **10. OPERATION OF THE SCHEME**

### **10.1. Maintenance and Management**

- 10.1.1. The A47/A11 Thickthorn Junction would continue to be managed by the Applicant on a day-to-day basis using the monitoring and control systems in accordance with the relevant design standards.
- 10.1.2. The Scheme has been designed with maintenance and safe operation in mind. Maintenance is defined within Article 2 of the Draft DCO (**TR010037/APP/3.1**) as actions needed to inspect, repair, adjust, alter, remove, replace or reconstruct all aspects that relate to the Scheme.
- 10.1.3. Long-term maintenance and repairs to the highways and associated assets (including drainage) would be undertaken as required to maintain the appropriate standards for the relevant highway authority. It is currently anticipated that the following would become the responsibility of Norfolk County Council:
- Cantley Lane Link Road (excluding structures over the A11 and A11-A47 Connector Road)
  - new junction connecting the B1172 Norwich Road to Cantley Lane Link Road
  - new junction connecting Cantley Lane South to Cantley Lane Link Road
  - Cantley Stream Culvert
  - WCH route from Cantley Lane South to Cantley Lane (excluding structure over A47).

### **10.2. Boundary Treatments**

- 10.2.1. During the design attention has been paid to the space required between the earthwork footprint and DCO boundary. As well as providing a highway boundary for safety and security, the permanent land take requirements have considered the need for earthworks, drainage and maintenance access strip between new structures and the Scheme operational highway boundary.
- 10.2.2. With the exception of where alternatives have been agreed with neighbouring landowners or special fencing is specified for environmental mitigation, timber post and rail fence will be provided in accordance with Manual of Contract Documents for Highway Works standard details.

### **10.3. Decommissioning**

- 10.3.1. It is considered highly unlikely that the Scheme would be demolished before the end of its design life of 60 years as the road would have become an integral part of the strategic road network.
- 10.3.2. In the event of the Scheme needing to be demolished, this would conform to the statutory process at that time, including a separate EIA if required.